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THE PLANT DISEASE REPORTER

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The Plant Disease Reporter is issued as a service to plant pathologists throughout the United States. It contains reports, summaries, observations, and comments submitted voluntarily by qualified observers. These reports often are in the form of suggestions, queries, and opinions, frequently purely tentative, offered for consideration or discussion rather than as matters of established fact. In accepting and publishing this material the Division of Mycology and Disease Survey serves merely as an informational clearing house. It does not assume responsibility for the subject matter.

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LOW INCIDENCE OF WHEAT LEAF RUST ASSOCIATED WITH UNFAVORABLE LATE WINTER WEATHER AND ANTAGONISM OF SEPTORIA TRITICI

K. Starr Chester

The relation of late winter weather to spring renewal of wheat leaf rust (Puccinia triticina Eriks.) [P. rubigo-vera var tritici] and the application of this in prognosis of rust epiphytotics has been the subject of two previous contributions to the Plant Disease Reporter[1]. The purpose of the present communication is to report the abnormally low incidence of wheat leaf rust in Oklahoma on April 1, 1944, and to point out the relation of this to the meteorological and pathological factors responsible, the conclusions being based on a series of detailed appraisals of the progress of leaf rust at 10-day intervals during the late winter period.

The previous reports dealt with a series of years characterized, in Oklahoma, by severe or light leaf rust, in which there was a consistent correlation between abnormally low temperatures during December-March or subnormal precipitation during January-March, or both, and minimal rust development. Temperatures and precipitation from April 1 onward showed no correlation with rust severity, i.e. the most decisive conditions governing the destructiveness of rust in any given season, were realized by April 1, 2-1/2 months before harvest.

The official weather record for December, 1943 to March, 1944, kindly supplied by Mr. W. E. Maughan, State Meteorologist, is given below:

	State Averages		
	1943-44 season	50-year average	Departure
Temperature, °F			
December	36.2	40.0	- 3.8
January	39.3	38.2	+ 1.1
February	44.9	41.0	+ 3.9
March*	45.8	49.0	- 3.2
Precipitation, inches			
December	3.10	1.70	+ 1.40
January	1.69	1.42	+ .27
February	2.86	1.35	+ 1.51
March	2.93	2.12	+ .81

* For the 28 wheat-producing counties in the western half of Oklahoma. Little or no wheat is grown in the eastern half.

[1] "A suggested basis for the prediction of wheat leaf rust epiphytotics," Pl. Dis. Reptr. 26: 213-217, 1942; "The decisive influence of late winter weather on wheat leaf rust epiphytotics," Pl. Dis. Reptr. Suppl. 143, 1943.

The weather of December-February influences leaf rust primarily through its direct and indirect influence on the survival of the rust, which normally has little opportunity for extensive reproduction during this period; the weather of February, and particularly of March affects the rust primarily through its influence on rust reproduction. The critical minimal temperature for reproduction of the fungus is very close to 50°F., which is the normal average temperature for March in Oklahoma. Departures from this average of only a few degrees, upward or downward, turn the balance in favor of or against the disease.

Turning now to the weather record for the 1943-1944 season in Oklahoma we find that December was abnormally cold but wet; January and February both showed average temperatures and precipitations above normal. Greatest interest attaches to March which although receiving more than normal precipitation, was abnormally cold throughout the wheat-growing half of Oklahoma. (The southeastern quarter of the State, in which no wheat is grown, had nearly normal temperatures, resulting in a State average in which the departure was -1.9°).

We can see from this that the temperatures of March were several degrees under the critical 50° below which rust reproduction is sharply curtailed.

Judging purely by this weather record, and on the basis of the correlation indicated above, one would expect to find leaf rust at a comparatively low level of intensity at the end of March. This was borne out by the results of the periodic determinations of rust intensity in Oklahoma during late winter.

The planting chosen for periodic inspection was of Cheyenne wheat which is very susceptible to leaf rust. It had been planted at the normal time, had made excellent growth, and was quite typical for the area. Nearby were two fields, with good stands of Turkey wheat, which is likewise very susceptible, and these were also examined to determine whether the experimental field was atypical in any respect. No such abnormality was found. In November, 1943, all three plantings were well infested with leaf rust, as is normal in Oklahoma.

Rust readings were begun January 31, and continued at 10-day intervals. On the occasion of each reading, 3000 or more individual leaves were examined in the laboratory with the use of the low-power wide-field microscope as needed. The leaves for each reading were taken at random from a score or more of probes, collected at random, typical points at wide intervals over the planting. No stem rust or other diseases, apart from leaf blotch, were observed. The results are given in the following table:

	Date	No. leaves examined	No. infected leaves	Average no. pustules/leaf
	I-31	3000	27	10.1
	II- 9	3000	6	12.2
Test	II-19	3000	9	3.4
Field	III- 1	3083	1	1
	III-11	3200	50	9.2
	III-21	3039	36	1.9
	III-31	3020	10	1.1
Control	IV- 1	1014	14	1.4
Fields	IV- 1	1052	15	1.1

Hence we see that by the first week in April, 1944 leaf rust was present in the experimental field only to the extent of 1 pustule on 1 leaf in 300. Examination of 3000 leaves consumes 6 to 8 hours, i.e. 1 leaf with 1 rust pustule was found on the average only once in 45 minutes; with the usual 5 or 10 minute search used in cereal disease surveying, the probability is that no rust would have been found.

In 1938, a year of epiphytotic leaf rust, Oklahoma wheat on April 1 "was so heavily infected that the fields already looked yellow and scorched."[2] Such an appearance of fields could only result if the average leaf showed 100 or more rust pustules, and a comparison of the 1938 season with the present one thus indicates that at the same time of year the wheat in 1944 had no more than 1/30,000th as much leaf rust infestation as in 1938.

The periodic examinations for leaf rust were made in the vicinity of Stillwater in the north-central part of Oklahoma. It was necessary to determine whether the low incidence of rust in this section was characteristic of the wheat throughout the western parts of the State where the principal acreages occur. This was accomplished by correspondence and by a survey trip made April 5 by Dr. Howard Larsh of the Emergency Plant Disease Prevention Project.

Doctor Larsh's trip followed an itinerary from El Reno north to Pondcreek through the greatest concentration of wheat acreages, while the two other important wheat sections, northwestern Oklahoma and southwestern Oklahoma, were reported on by Mr. V. C. Hubbard, Agronomist at the Dry Land Experiment Station at Woodward, and Mr. W. M. Osborn, Superintendent of the Dry Land Experiment Station at Lawton, respectively.

Mr. Hubbard wrote from Woodward on April 1:. "I have been expecting to find leaf rust for the past several weeks but have not found a single pustule."

Mr. Osborn reported on April 5 that no rust whatsoever could be found on susceptible varieties of wheat at Lawton, which is 125 miles south of Stillwater and only 30 miles north of the Texas line.

Dr. Larsh made 5-minute examinations of 48 fields and was unable to find a single pustule of rust in his 165-mile trip through the heart of Oklahoma's wheat belt. No other disease condition was noted, although the wheat had suffered light to moderate dieback of leaf tips due to a hard freeze in the last week of March.

Thus we find that the low incidence of leaf rust at Stillwater is characteristic of the situation for Oklahoma as a whole.

One can only speculate as to the length of time required in the future for the wheat in 1944 to attain infestation comparable to that in 1938. Greenhouse experiments during the past winter have shown that starting with a much higher amount of inoculum than was present in nature on April 1 in Oklahoma, and with ideal conditions for infection constantly maintained (wheat of a very susceptible variety and well fertilized with nitrogen; constant temperature of 65°F. which is optimal for infection; spore masses allowed to become powdery during the day, then dispersed by a light fine syringing and plants then subjected to artificial dew throughout every night), a month's time was required to increase the

[2]Plant Dis. Reptr. Suppl. 112: 3. 1939

infestation by an extent comparable to the difference between the natural infestations of April 1, 1944 and April 1, 1938. No less time than this, and probably much more, would be required under the fluctuating conditions of nature. A complicating factor might be the deposition on Oklahoma fields of great quantities of leaf rust spores from Texas, but there is little evidence thus far in reports of the Emergency Plant Disease Prevention surveyors that Texas fields are heavily enough infested to provide this air-borne inoculum.

Numerous investigators have demonstrated in various ways that severe leaf rust when wheat is in the boot or heading stages can reduce yields by as much as 50%, while a comparable amount of rust in soft and hard dough stages results in losses of 10% or less.

The foregoing considerations permit one to conclude with assurance that the odds are very great that leaf rust can not seriously damage the Oklahoma wheat crop in 1944.

The examinations of wheat at 10-day intervals also gave a revealing picture of the factors and phenomena involved in the unsuccessful course of leaf rust during the winter and early spring of 1943-44. Up to and including the reading of March 11, there was clear-cut evidence of the survival of fall infections in a relatively inactive stage. Leaves that had been infected in the fall and could be recognized by their age and large numbers of pustules (82 in one case) and by their activity as foci of infection from which isolated fresh single-pustule infections on nearby leaves had recently developed, were present on March 11 but not thereafter. In the examinations of March 21 and 31, there was no trace of living leaves that could have been present in the fall (first 3 leaves formed) and the fields no longer showed old foci of infection, but instead only young, isolated pustules were scattered here and there at random through the field and on leaves formed since fall. These could have been produced either by spread from the overwintered infections, before the overwintered leaves died, or they could conceivably have been due to spores blown north from Texas. The latter is unlikely, however, as this would require heavy infestation in Texas no later than March 10, and this is not known to have been present in Texas at that time.

In each examination there was abundant evidence of the vigorous development of speckled leaf blotch (Septoria tritici Desm.). By March, on the main wheat tillers that had developed approximately 7 leaves, 4 leaves had been destroyed by Septoria. This fungus progressed from the older, lower leaves upward. It first successively invaded the 3 oldest leaves, which bore fall rust infections. Before the last of these succumbed, and with it, its rust, the rust, if it was to survive, was forced to form new infections on the 4th and later-formed leaves. By mid-March the 4th and 5th leaves were the only ones bearing living rust, and with each successive examination one could see the steady progress of Septoria, engulfing the dwindling number of leaf rust pustules as first the 4th and then the 5th leaf was destroyed.

This was a major factor in the decline of leaf rust from the level of January 31 to almost the vanishing point on March 1, and, following a temporary rise in the first decade of March, its further decline in the two following decades. In winter and early spring Puccinia triticina

is racing against time and its success or failure depends on whether it can occupy new leaf tissue before the rapidly advancing Septoria tritici can destroy the leaves supporting leaf rust. The outcome of this race is governed by 2 principal factors: a) the effect of environment in favoring one organism at the expense of the other; and b) differences in the developmental characteristics of the two organisms.

Insofar as the environmental effect is concerned there is some similarity between these 2 fungi. Temperatures of 60°-75°F. are optimal for development of both. The extremes of the ranges of development of both fungi are about 35° and 90°F. Both require similar conditions of humidity for spore germination and infection. There is a great difference, however, in the length of time during which moisture must be present in order for infection to take place. Urediospores of Puccinia triticina will germinate and infect in high percentage if they are in contact with droplets of water for only 6 hours, while, according to conversations with Dr. Hurley Fellows, Septoria tritici spores must be under moist-chamber conditions for 15 to 30 hours in order that infection occur. This is undoubtedly a decisive factor ordinarily limiting the severe attack of Septoria tritici to the late fall, winter, and early spring months, periods in which, because of low temperatures, moisture may be continuously present during such long periods.

But while brevity of moist periods can limit the development of Septoria tritici in late spring, during the period of late winter under discussion this factor does not serve to explain the success or failure of Septoria tritici in its competition with Puccinia triticina. More decisive are the differences in the course of development of the 2 fungi. A single leaf rust infection does not involve more than a few square millimeters of leaf surface, and does not prevent the functioning of a vein. The destructiveness of leaf rust depends on the production of huge numbers of tiny lesions through repeated cycles of reproduction. In contrast, a single infection caused by Septoria tritici has the capacity of rapidly expanding until it occupies a large area of the wheat leaf; ultimately it may occupy an entire cross section of the leaf and once this occurs, the distal portion of the leaf dies. Very often infection will occur at the leaf base, where water droplets persist longest, and in such cases the entire leaf, together with any rust which it may have, will promptly die.

So we can see that under conditions permitting repeated cycles of reproduction, Puccinia triticina is favored; it is more dependent than Septoria tritici for its survival and destructiveness on multiplication of infections, since it is an obligate parasite and each infection is tiny and has a relatively short period of survival and functioning. Moreover, Puccinia triticina takes greater advantage of conditions favoring reproduction, since it requires a shorter period of moisture, and its incubation period is only about half as long as that of Septoria tritici.

In contrast, Septoria tritici is the favored competitor under conditions permitting few cycles of reproduction because of the greater ability of single infections to enlarge and destroy rust-bearing leaf tissue, directly or indirectly.

This competition between Septoria tritici and Puccinia triticina is analogous to that which has been reported by several Russian workers[3], in which the wheat leaf rust fungus is in competition with the snow-mold fungus, Fusarium nivale (Fr.) Ces. In places in the microrelief where the snow thaws slowly, where temperatures are 2-5°C. and there is little wind (e.g. by the edges of forests), Fusarium nivale is the agent of extensive destruction of wheat leaves under the snow, and with them of the overwintering leaf rust, while out in the open steppes the rust is held in check by exposure to low temperatures.

Thus we see that the winter attack of Septoria tritici has its beneficial aspects in interfering with the overwintering of the more dangerous leaf rust. It would be a mistake, however, to disregard the accompanying activity of Septoria as a primary agent of destruction of wheat leaves from late fall to early, or more rarely late spring. In the present season, by April 1, 5 of the 8 leaves that had been formed on main tillers of wheat had been prematurely destroyed by Septoria. Some damage to the wheat unquestionably resulted from this loss, but there is no experimental basis for determining how much. Pasturage on winter wheat must have suffered to the extent of at least 50%. Agronomists frequently express the view that it is hazardous for wheat to enter the winter in a rank or luxuriant state; it is considered to be more subject to winter injury. But if there is any benefit to the wheat plant in reducing its leaf area in the fall it would be far more economical to do this by grazing than to yield this excess foliage to Septoria, even assuming that such reduction is desirable,-- an equivocal point. Furthermore there is no compensation for foliage lost to Septoria in mid-winter and early spring other than the reduction in overwintering leaf rust consequent on leaf death from Septoria, and any good that might result from this effect of Septoria could be more economically and effectively achieved by using seedling resistance to check the overwintering of leaf rust. There is urgent need for experimental determination of the extent of the damage suffered from the direct attack of Septoria tritici in terms of winter pasture and of vigor and yielding capacity of plants that have lost foliage through the action of this fungus.

(Parenthetically, it would further a scientifically exact understanding of the course of life of winter wheat if "winter injury" to wheat were precisely analyzed; it is the writer's conviction that a preponderance of the damage to wheat that is loosely called "winter injury", and tacitly attributed to exposure to low temperatures and winter winds, is in reality due to the destruction of leaf tissue by Septoria tritici or the succumbing to winter hazards of leaves that are heavily infected with leaf rust, since, as is well known from the literature, such leaves are more susceptible to low temperatures than normal, uninfected leaves.)

Particular interest attaches to the question of whether the relationship between late winter weather and leaf rust renewal observed in Oklahoma has a counterpart in other wheat-growing areas. The greatest dif-

[3]Discussion of this relationship and literature references in: Naumov, N. A. "Rzhavchina Klebnikh Zlakov b SSSR" [The Rusts of Cereals in USSR]. Moscow and Leningrad, Selkhozgiz. 403 pp. 1939

ference in etiology of the rust, comparing southern with northern wheat areas, is that in the latter, spring renewal is usually considered to depend to a greater extent on air-borne inoculum brought from the South by winds, and to a lesser extent on overwintering of the rust in fields of winter wheat. Yet this difference is not so great as is often supposed. Schaal and others have shown that Puccinia triticina can overwinter in the uredial stage as far north as the Canadian border. Indeed, where there is protection by snow cover overwintering appears to be more easily accomplished than farther south where snow cover is intermittent or absent. Rusakov and Shitikova have shown that leaf rust protected by a deep snow cover will overwinter in West Siberia where temperatures fall to -50°C., while on the exposed, wind-blown steppes, in absence of snow cover, the rust can not survive. Furthermore, one would expect the effect on rust development of late winter weather to be essentially the same regardless of whether the inoculum is locally produced or brought in from a distance, since in either case the temperature and moisture requirements for infection will be the same.

To shed further light on this question, the relationship between late winter weather and rust development, as seen in Oklahoma, was analyzed for years of severe and light rust in Iowa and Illinois (l.c.) with results comparable to those in Oklahoma. More recently, in correspondence, Dr. K. D. Butler pointed out that the 5 years 1937-1941 were all years of severe wheat leaf rust in New York, and raised the question of the relationship of this to the weather record. It has been pointed out that in the latitude of Oklahoma the weather conditions of March are of greatest importance in determining epiphytotic leaf rust development. Phenologically March in Oklahoma corresponds approximately to the period from April 15 to May 15 in New York State. It is recalled that 50°F is the lower threshold temperature for effective leaf rust multiplication. During the 5 years in question the mean temperatures for New York rose, quite uniformly, from approximately 50°F. on April 15 to 62°F. on May 15, i.e. were in a range entirely favorable for early generations of rust reproduction. These temperatures correspond very closely to those for March in Oklahoma during years of severe rust and are much higher than the temperatures for March in Oklahoma, or the phenologically similar month of April in Illinois, during years in which this month's temperature was a limiting factor for rust development in these States. Thus, so far as temperature is concerned, the New York data are in close agreement with those for Oklahoma, Illinois, and Iowa.

Scanty precipitation in late winter and early spring may also be a limiting factor to leaf rust development. During these 5 years of severe rust in New York, the precipitation for the critical period was equal to or in excess of that in the other States during years of severe rust, and greater than that in the other States during years in which precipitation was a limiting factor to rust development. In this connection it should also be borne in mind that in New York there is a much greater conservation and accumulation of moisture, during the winter, because of higher average rainfall coupled with the long period of low temperatures during which evaporation is low and moisture is retained in the soil or as snow cover. However, winter temperature in New York State, in all

probability, is not a factor seriously limiting leaf rust survival because of protection by frequent snow and because the wheat varieties used are more winter-hardy than those planted farther south. (Numerous workers have pointed out the close correlation between winter survival of the host plant and winter survival of wheat leaf rust as intramatrical mycelium.) Thus, as regards both temperatures and moisture, the relationship between weather and spring renewal of wheat leaf rust is similar in Oklahoma, Illinois, and New York.

Summary

1. Examinations, each of 3000 wheat leaves, at 10-day intervals from the end of January to April 1, revealed that there was no essential increase in the amount of wheat leaf rust during this critical period which determines, in Oklahoma, the future destructiveness of leaf rust for any given season (PDR Suppl. 143, 1943). By April 1, on the average, 1 leaf in 300 was infected with a single rust pustule, which is a rust concentration only 1/30,000th as great as that on April 1 of the leaf rust epiphytotic year 1938.

2. This low leaf rust incidence was associated with late winter temperatures that held the reproduction rate of Puccinia triticina to such a low level that Septoria tritici, each lesion of which has a greater capacity of destroying wheat leaf tissue than lesions of leaf rust, was able to destroy rust-infected wheat leaves as fast as the rust could advance with new infections.

3. By April 1, the 2 fungi, but particularly Septoria tritici, had destroyed approximately 5 of the 8 leaves that had developed on main tillers. The benefit of Septoria in holding leaf rust in check is probably greatly outweighed by its direct destruction of the wheat leaves, reducing winter pasturage and vigor of the plant as it emerges from winter dormancy.

4. Leaves that had been rusted in the fall in some cases survived as foci of infection until the middle of March; thereafter all rust infection found was of recent origin.

5. The low rust incidence observed at Stillwater was characteristic of all of the principal wheat areas of Oklahoma, as determined by correspondence and a survey of the main wheat belt.

6. With the failure of leaf rust to develop to more than an insignificant extent during the critical period of late winter, it is felt that the odds are very great that leaf rust, although it may be abundant by harvest time, will not materially affect the yield or quality of the 1944 Oklahoma wheat crop.

7. The correlation between weather in the critical late-winter period and leaf rust development which was previously pointed out for Oklahoma, Iowa, and Illinois, also was found to apply to New York State during the 5 years of severe leaf rust, 1937-1941.

OKLAHOMA AGRICULTURAL EXPERIMENT STATION, STILLWATER. April 6

CEREAL DISEASES IN THE CAROLINAS

R. E. Atkinson

During the past week (March 18-25) grain fields in Nash, Edgecombe, Wake, Vance, Granville, Davidson, Rowan, and Iredell Counties of North Carolina were visited, in company with Dr. S. G. Lehman.

As in the coastal plain of South Carolina, grain in eastern North Carolina is late compared with other years, owing to the severe drought of late fall that delayed planting until after November 15.

Powdery mildew (Erysiphe graminis) which was present only in trace amounts in wheat at Raleigh March 6, has increased rapidly and has involved all the lower leaves of susceptible varieties. The earliness of the attack may indicate another severe epidemic in wheat this year. An average of 20% reduction in yield was reported from eastern South Carolina last year.

Powdery mildew noticeably appears first on barley and seems to build up inoculum on this host before wheat is heavily attacked.

Leaf rust of wheat (Puccinia triticina) [P. rubigo-vera var. tritici], reported from Raleigh March 6, has increased slightly in prevalence. Many chlorotic flecks which may be early rust infections were seen this week at McCullars Experimental Farm near Raleigh. Wheat leaf rust was also found at Statesville in trace amounts. Leaf rusts of rye (P. dispersa) [P. rubigo-vera var. secalis] and of barley (P. anomala) have not increased conspicuously and are still present only in trace amounts.

The relative absence of rust at this time is regarded as surprising and may indicate less damage than usual, although wheat is still 3 or 4 weeks from heading.

Crown rust of oats (P. coronata) has not been observed in either State this year.

Septoria tritici was found this week in the wheat varietal test plots at Statesville, North Carolina. Although it was too early to take notes on varietal reaction, it was obvious that most varieties were susceptible to this leaf spot.

Leaf spot of oats (Helminthosporium avenae) was found in almost every field of oats examined. Its presence could almost be used to distinguish oats from other grain at this time. In only 2 fields was it severe enough to be causing damage; both were considerably more advanced than the average field.

A leaf spot of barley caused by Septoria passerinii is also widespread throughout the 2 States but as yet is of no economic importance.

Root Rot and Foot Rot. Probably the most destructive disease on cereals in North and South Carolina is root and foot rot. The direct or indirect causes of this disease complex are unknown. The majority of fields seen from the road are a mottled green with patches of yellow. On close examination the yellowed areas are seen to be composed of plants with yellowed or dead lower leaves, with here and there stunted plants, and sometimes many plants dead or dying. Tillering is lacking in affected plants.

Probably some of the milder manifestations are entirely due to mineral deficiencies, but the more severe cases seem to be obviously of fungous origin. There is no perceptible difference in the symptoms in various fields except in degree of severity.

Severe symptoms have been seen most commonly in fields of oats, but wheat and barley fields also are affected. The trouble has been noted throughout North and South Carolina, the most severe cases observed being in Lee County in South Carolina and Vance and Granville Counties in North Carolina. The last-mentioned field was a mixture of oats and barley with both cereals affected.

The number of plants completely killed in the severely affected fields is amazing. In the affected patches sometimes 25% of the plants are killed, sometimes the whole field is affected and from 50 to 80% of the plants are dead or dying. This condition is hesitatingly ascribed to cold injury by the farmers. However, the roots and crown of affected plants are killed before the above-ground portion dies.

Unidentified Disease. A dark mottling of barley leaves, the dark areas often appearing as concentric rings on small spots, which later enlarge or fuse to involve the entire width of the leaf, was observed at an experimental farm near Raleigh on certain selections from the Sunrise variety. Another characteristic symptom is the bending of the leaves at the affected portions, apparently due to the lack of turgor of the cells involved. This trouble has been variously diagnosed, but was most commonly called "sun scald" when it first appeared last year. However, conditions conducive to sun scald have not obtained this year.

EMERGENCY PLANT DISEASE PREVENTION PROJECT

DISEASES ON SMALL GRAINS IN TEXAS

G. M. Watkins

On March 28 to 31 a trip was made through the small grain section of the Bosque River Valley, chiefly in Bosque County; the section comprising Young, Archer, Baylor, Wilbarger, Foard, Knox, Haskell, and Jones Counties; and the area centered chiefly in Mason, Gillespie, and Blanco Counties. The following diseases were observed.

Oats -- Numerous fields of oats were seen in Bosque, Gillespie, and Blanco Counties, and occasional fields were examined in the other counties mentioned. A trace of halo leaf blight (Pseudomonas coronafaciens) occurred in nearly all fields, but was moderately serious in only one field near Clifton, Bosque County. Helminthosporium avenae was present in most fields as a trace. A single infection center of crown rust (Puccinia coronata) was observed in a field near Stonewall, Gillespie County.

Wheat -- Speckled leaf blotch (Septoria tritici) was common on lower leaves, causing slight damage, in every field seen throughout all areas surveyed. Leaf rust (Puccinia rubigo-vera var. tritici) was generally distributed and was serious in most fields seen in Bosque County. In a 50-acre field at the edge of Seymour, Baylor County, 2 infection centers

were located in which a few uredinia of leaf rust were just maturing. This was the northernmost point at which leaf rust was identified on this trip. Several infection centers were located in a field of Tenmarq wheat 7 miles north of Brady, McCulloch County. In Gillespie and Blanco Counties leaf rust was general in all fields examined and will probably cause heavy reduction in yield, since the plants will be in the boot stage within 2 weeks. No stem rust was seen on this trip.

Barley -- Small plantings were encountered occasionally and were free from disease, except for a trace of spot blotch (Helminthosporium sativum), which was seen in 1 field in Bosque County.

EMERGENCY PLANT DISEASE PREVENTION PROJECT

SCLEROTINIA STEM ROT OF LEGUMES IN TENNESSEE

R. A. Hyre

During the period March 20 to 25, the survey for stem rot of legumes, caused by Sclerotinia trifoliorum, was continued across northern Tennessee and south to Memphis. Stem rot was most severe on fall-seeded alfalfa; it was less severe on crimson clover. Very little was found on red clover and virtually none on older alfalfa.

Eighty-five acres of fall-seeded alfalfa were observed in 12 fields. Stem rot varied from a trace to 30% of the plants affected in 82 acres, with most of the affected acreage showing from 5 to 10%. Cool wet weather was favoring its continued spread.

A trace of stem rot was seen in 10 of the 92 acres of older alfalfa examined.

On 87 acres of crimson clover in 16 fields, stem rot occurred on 55 acres, mostly in traces to 1 to 2%. On 10 acres with 30% of stem rot, red clover, lespedeza, and tall weeds had been turned under just before seeding to crimson clover.

A trace of stem rot occurred in 4 of the 20 acres of red clover seen.

From March 27 to 31, the survey was continued from Jackson eastward to Columbia, McMinnville, and Knoxville. A trace of stem rot was found in 42 acres in 5 fields of fall-seeded alfalfa. In an additional 40 acres in 3 fields, from 5 to 30% of the disease was present. An outbreak occurred in the vicinity of Columbia, where the County Agricultural Agent received 10 or 12 complaints from farmers. The Bedford County Agent reported "numerous" complaints on fall-seeded alfalfa.

On older alfalfa no crown rot was seen on 120 acres in 13 fields. However, in many of the fields reduction in stand up to 30% or more, frequently with barren spots of considerable size, indicated the earlier occurrence of this disease.

Only a trace was seen in 40 acres of red clover and 60 acres of crimson clover. At the Columbia Experiment Station a considerable amount of crown rot occurred in several acres of button medic.

EMERGENCY PLANT DISEASE PREVENTION PROJECT

ALFALFA DISEASES IN ARIZONA AND NEW MEXICO

Wm. G. Hoyman

Alfalfa is grown extensively in the agricultural valleys of Arizona and New Mexico. At the higher altitudes it is not uncommon to find it growing wherever farming is practiced. Since August, 1943, all the alfalfa-producing areas of both States have been visited and sufficient information has been obtained to give some idea as to the prevalence and severity of certain diseases.

Corynebacterium insidiosum, the cause of bacterial wilt, was found to be widespread in both States and was causing more damage than any other pathogen. In Arizona, alfalfa was growing in 11 of 12 counties surveyed, and bacterial wilt was observed in 10. Moderate to severe losses from this disease were observed in Yavapai County where several dairy farmers attempt to maintain stands for hay and pasturing. As expected, the losses from bacterial wilt at other localities in Arizona were more noticeable where the stands were left for several years. In New Mexico, bacterial wilt was common in Dona Ana, Chaves, and Eddy Counties. Alfalfa was found growing in 17 counties and bacterial wilt was observed in 16.

Phymatotrichum omnivorum was observed in southern Arizona and New Mexico counties, causing more damage in the former State. The losses from root rot were more than from any other disease except bacterial wilt.

Other diseases found in Arizona were those caused by Pseudopeziza medicaginis, Colletotrichum trifolii, Peronospora trifoliorum, Uromyces medicaginis [U. striatus], Cuscuta sp., Fusarium oxysporum var. medicaginis, Rhizoctonia solani, and the virus diseases mosaic and witches' broom. Rhizoctonia root canker was observed only in Yuma County. Girdle was observed in 6 counties. Of the above diseases, the loss from any one may have been as much as severe in some instances but such cases were in the minority.

Peronospora trifoliorum, Pseudopeziza medicaginis, Uromyces medicaginis, Ascochyta imperfecta, Cuscuta sp., white spot and girdle were also observed in New Mexico. The loss from any one was seldom more than moderate.

The loss from bacterial wilt in both States is no doubt more than the losses from all the other diseases combined. This disease may be found in isolated places where alfalfa has never been grown. The altitude does not appear to have any influence on its prevalence.

Extensive experiments by Professor Ian A. Briggs of the Department of Agronomy, University of Arizona, have proven that alfalfa is adapted to the Yuma Mesa. On November 10, 1943, several alfalfa diseases were noticed at the University of Arizona Experimental Farm located on the Yuma Mesa. Corynebacterium insidiosum, Rhizoctonia solani, Fusarium oxysporum var. medicaginis, Uromyces medicaginis, witches' broom, mosaic, and girdle were present but none doing more than a slight damage. The loss from all together, however, was considerable. Witches' broom was not observed at any other location in the 2 States except the Yuma Mesa. Rhizoctonia root canker was found only on the Yuma Mesa and in the

Yuma Valley. Mosaic was more prevalent at Yuma than elsewhere. Phymatotrichum omnivorum was not observed on the Yuma Mesa during November but it is quite possible it occurs there since it is known to be present in the Yuma Valley.

The presence of more alfalfa diseases at Yuma than at any other location in Arizona and New Mexico is not too encouraging in view of the fact that the United States Bureau of Reclamation has chosen alfalfa as one of the crops to be seeded on the Yuma Mesa.

EMERGENCY PLANT DISEASE PREVENTION PROJECT

OTHER REPORTS ON DISEASES OF CEREAL AND FORAGE CROPS

LEAF SPOT OF OATS IN LOUISIANA: A considerable amount of leaf spot (Helminthosporium sp.) was found on plants growing near Crowley, Acadia Parish. -- Douglas C. Bain, Emergency Plant Disease Prevention Project. Mar. 20-25.

LEAF SPOTS OF ALFALFA IN TEXAS: Numerous fields were examined in Wilbarger County. Pyrenopeziza medicaginis and Pseudopeziza medicaginis were generally distributed, but appeared to be causing only minor damage. -- G. M. Watkins, Emergency Plant Disease Prevention Project. Mar. 28-31

LEAF SPOT ON SPOTTED BURR CLOVER IN SOUTHWESTERN MISSISSIPPI: In one small acreage near Summit (Pike County) there was a heavy infection of Pleospora herbarum. -- Douglas C. Bain, Emergency Plant Disease Prevention Project. Week ending Apr. 1

DISEASES OF AUSTRIAN WINTER PEA IN SOUTHWESTERN MISSISSIPPI: Several fields were surveyed in the McComb-Brookhaven-Hazelhurst area. The plants appeared to be in very good condition. Traces of downy mildew (Peronospora viciae) were found in fields near Summit (Pike County). Near Brookhaven (Lincoln County) a small amount of leaf spot (Septoria pisi) was observed in 1 field of about 5 acres.

A peculiar conditions was noted in 2 adjacent fields near Summit. Some buds and tendrils on many plants were water-soaked and somewhat slimy. Often only the apical portion of the bud was thus affected. There was no spotting of the leaves. It appeared as though freezing or hail injury had been followed by a soft rot; however, there had been neither frost nor hail recently and the condition was not general enough for that type of injury. The symptoms did not suggest bacterial blight and there was no evidence of fungous activity. -- Douglas C. Bain, Emergency Plant Disease Prevention Project. Week ending Apr. 1.

ASCOCHYTA BLIGHT OF AUSTRIAN WINTER PEAS IN TEXAS: About 5 acres of Austrian winter peas were examined near Waco, McLennan County. They had been grown as a winter soil-building crop and were about knee-high. Ascochyta blight (Mycosphaerella pinodes ?) was present on almost all plants, but at the time had involved only the lower leaves and stems. If the grower succeeded in turning under the vines without delay, the

loss was no doubt small. Otherwise the loss might be considerable. -- G. M. Watkins, Emergency Plant Disease Prevention Project. Mar. 28-31

DISEASES OF VETCH IN MISSISSIPPI: Anthracnose (Colletotrichum viciae) was found in all of the many small fields surveyed in Copiah, Lawrence, and Marion Counties in southwestern Mississippi during the week ending April 1. Infection was light and there appeared to be no damage at all.

Single conidial cultures made from badly diseased material collected at Starkville (see report for March 6-11, PDR Mar. 15, p. 188) indicate that 2 fungi are involved instead of only Protocoronospora nigricans, the other fungus being Colletotrichum viciae. The specific relationship of the 2 organisms to the disease presents an interesting problem. -- Douglas C. Bain, Emergency Plant Disease Prevention Project.

LOSSES IN STORED POTATOES IN MAINE

Robert C. Cassell

Potato Storage Conditions in Aroostook County (February 1)

Shrinkage of the 1943 crop is extraordinarily high, undoubtedly the greatest in the memory of the present producers in the County.

A loss of over 41% would be required to reduce the 1943 Maine potato crop to the 1942 level. This seems quite unlikely in spite of the fact that the loss in some areas of Aroostook County will probably be that great. The important thing is that some of the largest producing areas of Aroostook will probably experience losses no greater than 20 to 30%, which, of course, is serious enough.

A heavy loss in Aroostook County, and one not detracting from the total record yield estimate of 73,485,000 harvested bushels in Maine in 1943, was the 5000 acres of potatoes not dug before the winter freezes occurred. These potatoes will be a total loss as the ground has frozen this year with the potato ridges exposed above snow coverage. This condition still exists in the first week of February.

It seems fair to assume at the present time that the shrinkage of stored potatoes in Aroostook County will be at least 25% (about 18,371,250 bushels). It is doubtful whether the final figure could be much less than 25% but it is not inconceivable that it could easily be up to 30%. The probable losses as they appear at present range in different areas from 20% up to 40%.

To get a true picture of the present potato storage conditions and their causes it is necessary to reconsider briefly the growing season of 1943 and the circumstances under which the crop was harvested. The planting season was very late and wet. The summer was too dry in the early part and too wet in the later part. A heavy freeze occurred about the 10th of October and the latter part of the digging in November was done in rain and mud. The "oversized" crop was tended with a minimum of labor and much of the labor was inexperienced. Too many potatoes were put into old storages and into those newly constructed.

The 6 major causes of shrinkage at the present time are field sunburn,

field frost, hollow heart, late blight, bacterial slimy rot, and crowded storage houses. Other causes of generally less importance are ring rot, blackleg, net necrosis, stem-end browning, and scab.

Field and storage conditions already reported (PDR 27(22):618, 1943) alone have probably accounted, directly and indirectly, for about two-thirds of the total shrinkage this year.

No attempt was made in this survey to get the percentage of field sunburn present but the November survey of storages found 78% of 45 bins to contain sunburnt tubers. The prevalence of sunburn was about 30% in the Katahdin and Sebago bins, and other varieties ranged from a trace to 15%. The amount of sunburn at present would of course be about the same except where such tubers have been graded out. A count would be hard to obtain now in many bins because of the prevailing wet and muddy conditions.

Hollow heart is exceptionally bad this year. It is present to some extent in all varieties and is especially important in the Katahdin, Sebago, Chippewa, and Cobbler varieties. The percentage of seconds is relatively small this year and the percentage of oversized and hollow hearted tubers is exceedingly large. According to the State inspectors some lots have run up to 25% hollow heart. Most of the hollow tubers are still firm but some are breaking down with a watery cavity.

External slimy soft rot (bacterial) is causing a heavy loss in most areas and is probably the cause of the greater part of breakdown occurring in shipment. On December 30 a car of potatoes left Presque Isle which was graded less than 1% defective. The car was opened seven days later in New York City with 50 to 75% slimy rot. This serves as an example of many other similar cases. External slimy rot is appearing in wet and muddy bins causing a pitting of the tubers and in places it is accompanied by heating which practically cooks the potatoes. Slimy rot pits ranged in size from a pin point to pits the size of a quarter. In many cases whole portions of the tuber are rotted. Slimy rot is causing losses ranging from portions of bins to the whole bin of 300 to 500 barrels or more.

The general presence of wet bins in Aroostook County this year reverts back to several apparently contributing factors already discussed (l.c.). In all of the wet bins sawdust has been generally and effectively used in the drying and salvaging process. Sawdust is scattered over wet bins, and is thrown over the tubers as they go over the brushes in order to remove mud and help to dry them. Although some bins require 3 and 4 brushings, most bins can be bagged directly after one brushing and grading without further drying.

Between 50,000 and 75,000 acres were dug after the October 10th freeze. The November survey found 90% of the fields to have frost-damaged potatoes. Prevalence ranged from a trace to 45% damaged tubers with an average of 2% or 3% for 28 fields examined. Out of 73 houses visited at this time 48 had one or more bins in which field-frost damage is or has been an important factor in the shrinkage. The greatest loss found from frost damage was 20% in one farm storage.

Late blight (Phytophthora infestans). If all other factors of shrinkage were disregarded, Aroostook County would have suffered a loss of nearly 10% from late blight alone this year. At present an average prevalence

of 16% was found in 110 bins where late blight records were taken. The incidence of late blight in the bins has now been exaggerated by other contributing factors, but nevertheless the great majority of bins have from a trace to 75% blighted tubers. The dump pile cleanup campaign next spring will be at a serious disadvantage because of the great quantity of the potatoes being hauled out and dumped this winter, most of which carries late blight in varying proportions.

Ring rot (Corynebacterium sepedonicum). Ring rot was found in 21 of 56 bins critically examined for its presence. Prevalence ranged from a trace to 15% with an average of 3.5% for the 21 bins. It was found in all towns visited but there was actually only one house in which ring rot appeared to be the principal primary cause of the present serious rot problem. In this house frost damage and late blight were also present and a total loss for the house of 7,200 barrels was anticipated to be 35% to 40%.

Net necrosis (leaf-roll virus). The incidence of net necrosis is much less in Aroostook County this year than it was last year. It was found in 18 out of 40 bins of Green Mountain and Cobblers. Prevalence ranged from 1% to 40% with an average of 12.5% for the 18 bins.

Stem-end browning (cause unknown). Stem-end browning was found in 28 out of 40 bins of Green Mountain and Cobblers. Prevalence ranged from 1% to 70% with an average for the 28 bins of 28.0%.

Scab (Actinomyces scabies). Scab was found in only seven lots of potatoes. Its occurrence in Aroostook County is negligible, generally speaking.

Blackleg (Erwinia atroseptica) [E. phytophthora]. Blackleg was found in nine lots of potatoes. It ranged from a trace to 4%.

Fusarium sp. Fusarium was found as a trace only in a few bins.

In this survey no particular effort was made to distinguish between shrinkage in table stock and in certified seed. However, it is impossible to ignore the difference in lots even for the sake of a general plant disease survey. Certified lots as a whole are much more nearly disease-free than table stocks but they are subject to about the same losses as table stocks where sunburn, field frost, and slimy rot are concerned. More allowance can be made for sunburn in seed, however, than in table stock.

It is the opinion of shippers in Aroostook County that there should be no critical seed situation this spring such as existed last spring. That is true if buyers outside of Maine are willing to take their shipments from now on and create a regular flow of seed shipment. However, if buyers insist upon the customary spring deliveries, car shortages will likely create a false seed shortage and encourage a black market. Some companies may not be able to make satisfactory deliveries if they have an established reputation of quality to maintain. Nevertheless there apparently is an ample source of seed potatoes, of such quality as prevails this year, provided it can be moved out of Maine in an orderly fashion.

It is estimated that some 9,000 to 9,500 cars of Maine potatoes will be made into starch or be dehydrated this year. Last year 3,400 cars were

converted into starch and this year it will be about 7,000 to 7,500 cars. Dehydration will consume from 1,700 to 2,000 cars. (Approximately 273 bbls. to a car, 11 and 12 pk. bbls.)

Potato Storage Conditions in Central Maine (April 1):

Potato growers and dealers in the towns of Dover-Foxcroft, Milo, La Grange, Corinna, Lincoln, Newport, East Newport, Dexter, and Charleston were visited. The producers of this area, as well as of the whole State of Maine, have more potatoes on hand than they would like for this late in the marketing season. Most dealers in central Maine believe that about one-third of their marketable crop of potatoes is still on hand. Potatoes are moving very slowly now and prospects for a satisfactory marketing of the remainder of the crop are none too bright. Some potato houses in the area have one or more cars of potatoes sacked for shipment but lack an available outlet. One large grower in Newport had diverted practically all of his certified Houma seed potatoes and some of his certified Katahdins to the local dehydrating plant because of a lack of demand for them as seed. On the other hand a shortage of good Green Mountain certified seed is now in evidence. The Katahdins were among the cleanest seed seen in the area.

Shrinkage losses in central Maine are less this year than in Aroostook County. However, individual cases of heavy losses do exist. One large producer in Dexter has suffered the heaviest losses this year that he has ever experienced. He lost 1,250 barrels out of 1,850 barrels of certified Green Mountain seed. Approximately 50% of the loss was due to late blight bin rot and the remainder to net necrosis, stem-end browning, bruises, etc. Another grower in Dexter lost about 30% of 16,000 barrels harvested. His greatest loss was in Katahdins which was almost 50%. The Green Mountain shrinkage was nearer 20%. Except for late blight rot which was bad, this man's losses were principally due to bruising the potatoes at harvest time by inexperienced labor and the poor keeping of such potatoes in storage. A grower in La Grange suffered losses ranging from 5% to 100% depending upon the variety; counts established the following losses: Sequoia 100%, Chippewa 30%, Katahdin 15%, and Green Mountain 10%. The average shrinkage loss was estimated at 20%. Principal losses were caused by late blight rot, field frost, and hollow heart in the order named. A dealer in Dover-Foxcroft harvested and contracted for 90,000 barrels but does not expect to market over 60,000 barrels.

As nearly as could be determined by the opinions and records of the potato men of central Maine the average shrinkage loss in the area will be between 20% and 22% for the storage season. This represents a loss over twice as great as experienced in a normal season.

Although the cases of individual losses cited above might indicate that the greatest losses were occurring in varieties other than Green Mountain, such is not the case for the area as a whole. The greatest loss by varieties is being experienced in Green Mountain with a probable average shrinkage of 25% for the area. Losses in other varieties average one-half to three-fourths of this figure. In Aroostook County, on the other hand, losses in February were less in Green Mountain than with other varieties because of the development of slimy soft rot in the bins and

in shipments of the other varieties. In central Maine slimy rot is a negligible factor and late blight rot, net necrosis, and stem-end browning have succeeded in making Green Mountain the "object-variety" of the loss column.

Most bins with serious late blight rot have been graded and moved, and others have been regraded. Nevertheless, blight rot remains the chief cause of shrinkage in the central Maine area this year. In the present inspection some bins were found with no detectable blight rot but the records of others show the following percentages: 4, 5, 10, 40, and 60.

The next 4 important causes of loss are field frost, net necrosis, stem-end browning, and hollow heart. The relative amount of loss caused by each might be in the order listed, but it is hard to tell with certainty. Practically all the tuber loss from field frost has been disposed of. Several lots of Green Mountains were seen where no net necrosis was evident, but other lots ran as high as 15% to 40%. Some lots were free from stem-end browning and others averaged from 15% to 35%. The 100% loss of Sequoias referred to above was caused by hollow heart. Cut of 800 barrels 200 sacks (100 lbs.) were salvaged as culls. A carload of 2 1/2 inch Sebagos in Dexter averaged 9% hollow heart. A bin of Katahdins in Corinna averaged 20% hollow heart.

It was suggested in the Aroostook County report above that potato dump piles in Maine would probably constitute a serious menace in the spread of late blight next year if the season is favorable for the spread of blight. With the great amount of blighted tubers being hauled to dumps this winter there should be a tremendous amount of potential inoculum present. It is inconceivable that all potato dumps will be adequately covered or otherwise taken care of to avoid volunteer sproutings next spring. Five potato dumps ranging in size from a few barrels to a few cars were seen in Newport, Corinna, Dexter, and La Grange. With the greater amounts of potatoes being dumped in Aroostook County it is very likely that dump piles will be even a greater menace there.

EMERGENCY PLANT DISEASE PREVENTION PROJECT.

STORAGE DISEASES OF POTATOES IN WASHINGTON AND OREGON

Lytton W. Boyle

WASHINGTON: From March 6 - 12, 1944 Yakima, Benton, and Walla Walla Counties were visited. According to reports of leaders among potato producers, 7,500 acres were planted with this crop in the area about Wapato the past season. Severe losses were sustained on approximately half of this acreage. Gross yields were about 50% of what was expected and where yields had been 6-7 tons of No. 1 grade tubers, one ton was obtained. From limited observation it appears as if an equally serious condition extends into the adjacent county of Benton. The loss in Yakima and Benton Counties probably exceeds 22,500 tons of the No. 1 grade potatoes for which this area has established a reputation in the past.

A number of diseases and pests contribute to these losses. Flea beetles and aphids were reported to have been very prevalent. A virus disease

referred to as "leaf curl" was considered to be of primary import. Losses were reported to have been greater in the later, more commonly grown Netted Gem, than in the earlier varieties.

The tubers in most lots observed in storage were of comparatively small average size. Losses due to rot in storage were small. Storage in this more arid cool region apparently holds such loss to a minimum.

Net necrosis caused serious losses. This was evident to some degree in the majority of lots examined. In several lots as high as 50% of the tubers showed this condition. Much money and labor could be saved if farmers would check for this condition in their tubers before the work of sorting and grading.

Net necrosis is commonly thought of as a symptom of the leaf roll virus. In this case, it is claimed by certain ones in the area, that typical leaf roll was not prevalent and the possible correlation of net necrosis with leaf curl is suspected.

Traces of ringrot (Corynebacterium sepedonicum) were noted in 2 lots.

No opportunity was found to observe potato storage in Franklin County. Several storage pits were examined in Walla Walla County. A very low percentage of storage rots was found in these but no necrosis was found in the tubers.

The experience of the past season will cause a serious reduction in acreage in Yakima and Benton Counties. Many growers comment that they can not afford to gamble on this crop another season and are looking to other crops or livestock to gain revenue from the land.

OREGON: - March 13-16, 1944. Potatoes observed in the cellars of the Milton-Freewater area had kept well. Only a trace of wet rot and a very small percentage of dry rot was evident. In the foot hills of this area, the season is comparatively short at the higher elevation. The tubers do not gain a large average size and much of this production is sold for seed. Net necrosis was not evident in the tubers observed at either the cellars or the storage of the local dehydration plant. Irregularly shaped tubers were causing the greater loss in the dehydration process.

The loss of tubers in the Parkdale area is estimated to be between 5 - 7% from dry rot and rhizoctonia. The dry rot commonly noted in this area was distinctive because of the sulphur-like color of the fungous mat. In some bins the potatoes tended to be knobby. Growers in these instances reported a heavy infestation of Rhizoctonia in their fields. Sclerotia were evident on a large percentage of the tubers.

EMERGENCY PLANT DISEASE PREVENTION PROJECT.

APPLE STORAGE DISEASES IN NEW YORK

Leon J. Tyler

The following is a summary of observations, concerning apple storage rots, made in New York State during the period February 7, 1944 to March 25, 1944. Tabulated data are included in tables 1 and 2.

Table 1. Apple diseases, their relative prevalence and severity in fruit held in New York State cold storages. 1943 crop.

Disease	Type of cooling system: Overhead coils[a] — Fruit lots affected: No.	%	Pct. of fruits affected[d]: Range 0 to -	Ave.	Blower[b] — Fruit lots affected: No.	%	Pct. of fruits affected[d]: Range 0 to -	Ave.
Alternaria rot	28	12.1	4.0	0.18	4	5.0	2.0	.036
Gray mold	56	24.2	23.0	.48	17	21.5	9.0	.35
Spy spot[c]	32	65.3	47.0	7.1	8	61.5	11.0	3.0
Blue mold rot	85	36.7	23.0	.99	33	41.7	16.0	1.14
Scab	120	51.9	100.0	7.1	32	40.5	34.0	4.0
Rhizopus rot	7	3.0	4.0	0.02	0	0.0	--	--
Black rot	3	1.3	trace	0.014	4	5.0	tr	.062
Sooty blotch	1	0.4	--	tr	0	0.0	--	--
Fly speck	1	0.4	--	tr	1	1.2	--	tr
Brook fruit spot	2	0.8	2.0	.012	1	1.2	--	tr
Bullseye rot	1	0.4	--	tr	0	0.0	--	--
Blotch	4	1.7	3.0	.029	1	1.2	tr	tr
Cedar-apple rust	14	6.0	47.0	.67	10	12.6	10.0	.24
Quince rust	1	0.4	2.0	tr	1	1.2	3.0	tr
Bitter rot	1	0.4	--	tr	0	0.0	--	--
Brown rot	2	0.8	--	tr	1	1.2	--	tr
Bitter pit	60	25.9	51.0	2.0	18	21.5	15.0	1.2
Internal breakdown	28	12.1	27.0	.74	7	8.8	3.0	.12
Internal browning	8	3.4	91.0	.61	2	2.5	tr	tr
Water core	4	1.7	--	.08	2	2.5	--	tr
Common scald	30	12.9	80.0	1.8	11	13.9	41.0	1.8
Jonathan spot	0	0.0	--	--	2	2.5	80.0	1.02
Soft scald	2	0.8	2.0	tr	6	7.5	17.0	.36

[a] Except as noted the figures are based on the examination of 231 different lots of fruit.

[b] Except as noted the figures are based on the examination of 79 different lots of fruit.

[c] This disease appeared only on Northern Spy, figures are based on 49 lots examined in overhead coil storages, 13 in blower storages.

[d] The percentages are based on the examination of 50 to 200 fruits from each lot.

Table 2. Diseases of apples in New York State cold storages, their prevalence and severity. 1943 crop.

Variety[a] Disease	Type of cooling system[b]							
	Overhead coils				Blower			
	Number of lots		Pct. fruits affected[c]		Number of lots		Pct. fruits affected[c]	
	Examined	Affected	Range	Ave.	Examined	Affected	Range	Ave.
Northern Spy	49				12			
Blue mold		23	0-23.0	1.4		4	0-11.0	2.1
Gray mold		10	0- 5.0	0.36		2	0- 9.0	0.83
Spy spot[d]		32	0-47.0	7.1		8	0-11.0	3.0
Scab[e]		21[f]	0-36.0	6.7		3[g]	0-34.0	6.3
Bitter pit		36	0-36.0	4.6		10	0-12.0	4.7
Internal breakdown		24	0-18.0	2.5		6	0- 3.0	0.7
Alternaria rot		2	0-tr	tr		0		
Rhizopus rot		2	0-tr	tr		0		
Water core		0				2	0-3	0.4
Black rot		0				1	0-tr	tr
Sooty blotch		1	0-17.0	--				
Fly speck		0				1	0- 7.0	--
McIntosh	30				15			
Alternaria rot		7	0- 3.0	0.34		1	0- 1.0	
Blue mold rot		14	0-19.0	1.4		11	0- 2.0	0.93
Gray mold rot		15	0-23.0	1.3		6	0- 2.0	0.6
Rhizopus rot		1	0- 4.0	--		0	--	--
Scab		22[f]	0-43.0	9.9		10[g]	0-30.0	7.0
Common scald		6	0-13.0	0.86		3	0- 5.0	0.43
Baldwin	25				6			
Alternaria rot		2	0- 3.0	0.14		0		
Blue mold rot		6	0-10.0	0.68		3	0- 3.0	1.0
Gray mold rot		3	0- 3.0	0.24		2	0- 1.0	0.32
Rhizopus rot		1	0- 4.0	--		0	--	--
Brooks fruit spot		1	0-tr	--		0		
Scab		14[f]	0-100.0	12.6		2[g]	0- 4.0	1.3
Common scald		2	0- 3.0	--		2	0-15.0	--
Bitter pit		15	0-51.0	7.4		4	0-15.0	4.8
Internal browning		1	0-tr	--		0	--	--
Fly speck		1	0- 6.0	--		0	--	--
Bullseye rot		1	0-tr	--		0	--	--
Rome Beauty	23				5			
Alternaria rot		4	0- 2.0	0.19		0		
Blue mold rot		9	0- 4.0	0.5		1	0- 1.0	--
Gray mold rot		6	0- 5.0	0.36		1	0- 1.0	--
Blotch		1[f]	0- 3.0	--		0		
Scab		15[f]	0-37.0	5.4		2[g]	0- 3.0	1.0
Cedar-apple rust		8	0-47.0	5.8		3	0- 4.0	1.6
Quince rust		1	0- 2.0	--		0	--	--
Jonathan spot		0				1	0- 1.0	--

Table 2 (Continued)

Variety[a] Disease	Type of cooling system[b]: Overhead coils: Number of lots Examined	Overhead coils: Number of lots Affected	Overhead coils: Pct. fruits affected[c] Range	Overhead coils: Pct. fruits affected[c] Ave.	Blower: Number of lots Examined	Blower: Number of lots Affected	Blower: Pct. fruits affected[c] Range	Blower: Pct. fruits affected[c] Ave.
Ben Davis	15				3			
Alternaria rot		3	0- 4.0	0.53		0	--	--
Blue mold rot		4	0- 2.0	0.53		0	--	--
Gray mold rot		4	0- 2.0	0.26		0	--	--
Rhizopus rot		1	0-tr	--				
Scab		12[f]	0-87.0	14.5		2[g]	0-11.0	3.3
Cedar-apple rust		1	0- 4.0	--		2	0- 4.0	
Bitter pit		1	0-tr	--		0		
Delicious	15				7			
Alternaria rot		3	0-tr	--		2	0-tr	--
Blue mold rot		10	0- 4.0	1.0		3	0- 2.0	0.5
Gray mold rot		8	0- 7.0	0.95		3	0- 1.0	0.3
Scab		9[f]	0-35.0	8.8		5[g]	0-15.0	4.4
Quince rust		0	--	--		1	0- 3.0	--
Cedar-apple rust		0	--	--		1	0-10.0	--
Common scald		0	--	--		1	0- 2.0	--
Soft scald		0	--	--		1	0-tr	--
Bitter pit		2	0- 5.0	0.5		3	0- 6.0	1.7
Water core		2	0-17.0	1.2		0	--	--
Internal breakdown		1	0-tr	--		0	--	--
Internal browning		1	0-tr	--		1	0-tr	--
Rhode Island Greening	16				4			
Alternaria rot		1	0- 3.0	--		0	--	--
Black rot		2	0- 2.0	0.18		2	0- 2.0	0.6
Blue mold rot		3	0- 5.0	0.62		2	0- 1.0	0.37
Scab		3[f]	0-57.0	4.5		0		
Common scald		12	0-70.0	16.9		2	0-41.0	13.0
Internal browning		5	0-91.0	6.8		1	0.tr	--
Cortland	11				6			
Alternaria rot		3	0- 1.0	0.2		0	--	--
Blue mold rot		4	0-15.0	1.9		1	0- 2.0	--
Gray mold rot		3	0- 2.0	0.36		1	0- 1.0	--
Rhizopus rot		2	0- 2.0	0.22		0	--	--
Scab		5[f]	0-91.0	11.8		4[g]	0-33.0	8.3
Cedar-apple rust		0	--	--		1	0- 1.0	--
Common scald		3	0-80.0	8.0		2	0-31.0	8.1
Soft scald		0	--	--		4	0-17.0	4.6

Table 2 (continued)

Variety[a] Disease	Type of cooling system[b]								
	Overhead coils				Blower			
	Number of lots		Pct. fruits affected[c]		Number of lots		Pct. fruits affected[c]	
	Examined	Affected	Range	Ave.	Examined	Affected	Range	Ave.
Northwestern Greening	9							
Alternaria rot		2	0- 4.0	0.6			---	
Blue mold rot		4	0- 6.0	1.4				
Gray mold rot		1	0- 3.0	--				
Blotch		2	0- 3.0	0.5				
Brooks fruit spot		1	0- 2.0	--				
Scab		5[f]	0-16.0	5.5				
Common scald		2	0-11.0	1.5				
Soft scald		1	0-tr	--				
Water core		1	0- 1.0	--				
Internal breakdown		1	0-27.0	--				
Internal browning		1	0-30.0	--				
Golden Delicious	8				6			
Black rot		1	0-tr	--		0	--	--
Blue mold rot		3	0- 6.0	1.1		2	0-16.0	2.8
Blotch		1	0- 2.0			1	0- 3.0	--
Brooks fruit spot		0	--	--		1	0- 3.0	--
Scab		4[f]	0-15.0	2.5		2[g]	0- 4.0	0.8
Cedar rust		1	0- 2.0	--		3	0- 2.0	0.5
Soft scald		0	--	--		1	0-tr	--
Phomopsis rot		1	0-tr.	--				
Newtown Pippin	5				2			
Blue mold rot		0	--	--		2	0- 9.0	5.0
Gray mold rot		1	0-tr	--		1	0- 1.0	--
Scab		2[f]	0- 4.0	1.0		0	--	--
Winter Banana	4				2			
Alternaria rot		1	0- 1.0	--		1	0- 2.0	--
Black rot		0	--	--		1	0- 2.0	--
Blue mold rot		1	0-tr	--		1	0-tr	--
Gray mold rot		1	0- 4.0	--		0	--	--
Cedar-apple rust		3	0- 8.0	4.0		0	--	--
Soft scald		1	0- 2.0	--		0	--	--
Bitter pit		2	0- 2.0	--		1	0- 2.0	--
Tolman Sweet	2				1			
Blue mold rot		1	0- 2.0	--		1	--	tr
Common scald		1	0- 3.0	--		0	--	--

Table 2 (Continued)

Variety[a] Disease	Type of cooling system[b]							
	Overhead coils				Blower			
	Number of lots		Pct. fruits affected[c]		Number of lots		Pct. fruits affected[c]	
	Examined	Affected	Range	Ave.	Examined	Affected	Range	Ave.
Wealthy	3				1			
Blue mold rot		2	0- 7.0	2.6		0		3.0
Gray mold rot		2	0- 3.0	1.1		0	--	--
Scab		2[f]	0-27.0	9.6		0		
Common scald		2	0-tr	--		0	--	--
Sun scald		0	--	--		1		16.0
Stayman	3				2			
Scab		0	--	--		1[g]	0- 4.0	--
Common scald		0	--	--		1	0-23.0	--
Hendricks Sweet	2				0			
Blue mold rot		1	0- 2.0	--				
Gray mold rot		2	0- 3.0	1.7				
Scab		1	0- 1.0	--				
Common scald		2	0-12.0	8.0				
Jonathan					2			
Blue mold rot						2	0- 3.0	1.7
Gray mold rot						1	0- 2.0	--
Jonathan spot						1	0-80.0	--
Internal breakdown						1	0- 2.0	
Stark	2							
Alternaria rot		1	0- 2.0	--				
Scab		1	0- 3.0	--				
York	1							
Bitter pit		1	--	5.0				
Waggoner	1							
Blue mold rot		1		2.0				
Tompkins King	2							
Blue mold rot		2		tr				
Gray mold rot		2		tr				
Scab		2	11.0-17.0					
Bitter pit		2	2.0-5.0					
Water core		1	0.0-tr					
Internal breakdown		2	5.0-12.0					
Spitzenburg	1							
Scab		1		14.0				

Table 2 (Continued)

Variety[a] Disease	Type of cooling system[b]: Overhead coils: Number of lots Examined	Overhead coils: Number of lots Affected	Overhead coils: Pct. fruits affected[c] Range	Overhead coils: Pct. fruits affected[c] Ave.	Blower: Number of lots Examined	Blower: Number of lots Affected	Blower: Pct. fruits affected[c] Range	Blower: Pct. fruits affected[c] Ave.
Mammoth Black Twig	1							
Scab		1		5.0				
Bitter pit		1		32.0				
Kendall	1				1			
Alternaria rot		1		2.0		0		
Blue mold rot		1		2.0		1		1.0
Gray mold rot		1		1.0		1		tr
Scab		0				1		3.0
Gallia	1							
Cedar-apple rust		1		4.0	0			
Gano	1							
Scab		1		4.0				

[a] Data for all grades of a given variety are combined.

[b] In general there were but 2 types of cold storage cooling systems, see text for descriptions.

[c] From 50 to 200 fruits were examined in each lot.

[d] This disease was found to be equally prevalent in storages in Eastern, North Central and Western New York; it was far more severe on individual fruits in Eastern and North Central than it was in Western storages.

[e] Severity of apple scab:

L= light, Total scabbed area per fruit - 1/4 inch or less.

M= moderate, Total scabbed area per fruit = 1/4 to 1/2 inch in diameter.

H= heavy, Total scabbed area per fruit = 1/2 to 3/4 inch.

Percentages below relate to the number of lots and approximate severity on the different varieties which contained one or more scabbed fruits.

	[f]Fruit in overhead coil storage	[g]Fruit in blower storage
N. Spy	43% L; 57% M	33% L; 67% M
McIntosh	23% L; 77% M	40% L; 60% M
Baldwin	64% L; 36% M	All light
Rome Beauty	47% L; 53% M	All light
Ben Davis	41% L; 58% M; 1% H	50% L; 50% H
Red Delicious	55% L; 33% M; 12% H	60% L; 40% M
R. I. Greening	33% L; 67% M	
Cortland	20% L; 80% M	100% M
N. W. Greening	40% L; 40% M; 20% H	
Golden Delicious	All light	
Newton Pippin	All light	
Wealthy	50% L; 50% H	
Stayman	--	All light scab

Production -- Three principal regions in New York State produce apples commercially: 1. Eastern New York (including the Hudson and Mohawk River valleys and the Lake Champlain valley). 2. Central and North Central New York. 3. Western New York including Wayne County and others lying to the westward and bordering Lake Ontario.

The average annual production of apples in New York for recent years amounts to about 18 million bushels. All but 2 to 3 million bushels are produced in commercial orchards. About half of the crop is marketed as fresh fruit for consumer uses; about one-fourth goes to processing plants, and the remainder is utilized by those who grow the fruit or is not harvested. Processing of apples is carried on more extensively in Western New York than in the other areas.

The varieties of apples seen in cold storage are as follows: McIntosh, Cortland, Northern Spy, Rome Beauty, Baldwin, Delicious, Ben Davis, Golden Delicious, Rhode Island Greening, Northwestern Greening, Newtown Pippin, Winter Banana, Tolman Sweet, Wealthy, Stayman, Hendrick's Sweet, Jonathan, Stark, York, Waggoner, Tompkins King, Spitzenburg, Macoun, Mammoth Black Twig, Kendall, Gallia and Gano. From the number of lots encountered and quantities stored it would appear that the first nine varieties are the most important in New York State.

Storage -- Forty cold storage warehouses distributed over the 3 principal apple-growing areas were visited during the survey period. Thirty-two of the storages contained apples at the time of the visits, while 8 others were sold out and the fruit had been removed. Those from which all apples had been removed consisted of commercial storages that make a practice of storing very few apples (several encountered in Western New York), and commercial-grower-farm-storages from which the entire crop had been sold and moved early (several encountered in the Hudson Valley area).

Among the commercial storages the capacity for storing apples ranged from about 100,000 to 400,000 bushels, while the capacity of farm-storages ranged from about 10,000 to 40,000 bushels. Of the total stored in Eastern New York storages about one-third remained at the end of February. Of those stored in Western New York not more than one-fourth remained by the third week of March.

In general, there are just 2 types of cold storage warehouses, differentiated by the method of cooling the storage rooms. One type is characterized by the presence of several series of coil-like pipes, either suspended from and near the ceiling or strung on the sides of posts installed in parallel rows 15 to 20 feet apart and extending lengthwise of the room, through which brine is circulated by means of pumps. This type of cooling system depends, for the most part, upon natural convection currents for air circulation within the rooms, but in some houses the rapidity of air circulation is boosted by means of stationary or movable fans. With few exceptions, such fans appeared quite inadequate for the work to be done. The second type is characterized by the absence of frosted brine coils which, in some of the overhead-coil storages, appear to be very much in the way. In the second type the temperature of the room is brought to the desired point by means of brine-cooled air blown into the room at high velocity through strategically arranged conduits

near or on the ceiling, or through vents near the ceiling at one side. The blower is thermostat-controlled and thus operates intermittently. This feature is advantageous because early in the storage season there is need for rapid air movement to cool the great mass of fruit tissue quickly and uniformly. Because of the heat given off by newly stored fruit the blowers are on most of the time during the early storage season and tend, through rapid circulation of the cold air, to bring the fruit temperature quickly to the desired point. In the overhead-coil system where air movement depends largely upon convection currents it is doubtful whether fruit would be cooled so quickly and uniformly.

Notes were made concerning air temperature and humidity of apple storage rooms in all the plants visited. In general, these records show that blower-type storages usually are run at slightly higher temperatures than are the overhead-coil storages, while the reverse is true for humidity.

In 21 overhead-coil storages, the temperatures ranged from 29 to 35° F. The data in detail show that 1 storage was running at a temperature of 29°, 2 at 30-31°, 13 at 31-32.5°, 4 at 33° and 1 at 35°. In 11 blower-type storages the temperatures ranged from 32 to 35°. Of these, 2 were running at 32°, 1 at 32-33°, 4 at 33°, 3 at 34°, and 1 at 35°.

Air relative humidity in the overhead-coil storages tended to be 90% and in most cases probably much above this figure (at the low temperatures prevailing only very slight differences between wet and dry bulb readings could be obtained), since in several there was water on the floors, ceilings and walls. The relative humidity in blower-type storages usually appeared to be slightly higher than 90% but in 3 of 11 the humidity was 89%. It is well known, of course, that difficulty is sometimes experienced in keeping the humidity high enough in blower-type storages to prevent shrinkage of the fruits of such a variety as Golden Delicious. On the other hand, excessively high humidity in some of the overhead-coil storages led to considerable surface mold development.

Development of the undesirable surface molds (Penicillium spp. mostly), which impart a moldy flavor to fruit long in storage even though they may cause no decay, appears related to the humidity of the rooms, to the use of old mold-infested containers, and to general practices of cleanliness about the storage. Some data accumulated show that, in general, the surface molds were considerably more bothersome in overhead-coil storages than they were in blower-type storages. The prevalence of surface molds on the structural parts of the rooms ranged from moderate to heavy in 10 of the overhead-coil storages, light in 6, and from none to very light in the remaining 5. For blower-type storages the mold prevalence was light in 3 and ranged from none to very light in the remaining 8. On storage containers, mold prevalence was moderate to heavy in 10 of the overhead-coil storages, and very light to light on containers in 11. In blower-type storages, surface molds were moderate on containers in 1, light in 2, and ranged from a trace to very light on containers in 8. Surface mold was moderate to heavy on the fruit in 7 of the overhead-coil storages, light in 8, and it varied from a bare trace to very light in 6. In blower-type storages, surface mold was moderate on the fruit in 1, very light to a trace in 7, and in 3 surface molds on the fruit were not evident. Usually, in storages where surface molds were heavy, on ceilings,

walls, containers, and on the fruits, the air moisture seemed excessively high and frequently considerable water was standing on the floors and dripping from the ceilings. Without exception, storages exhibiting such conditions were of the overhead-coil type.

Examination of hundreds of storage containers, i.e. crates, boxes, and baskets, revealed that surface molds were much more abundant on old, used ones. Because of an acute shortage of new containers in the past year many old ones were pressed into use and this practice obviously helped to increase the mold population everywhere in the storages. However, the use of new containers is not a complete solution for this problem because surface molds frequently were noted on new boxes and crates.

Good sanitation does not appear to be commonly practiced in the cold storage plants visited. Of 32 in which apples were stored, 1 is disinfested occasionally with formaldehyde spray; 2 are consistently fumigated with ozone gas, washed and whitewashed; 1 is sprayed with lime-sulfur; 1 is sprayed with calcium hypochlorite; 5 are aerated during the summer and whitewashed occasionally; surface molds are occasionally scraped from the interior surfaces of one and the surfaces repainted; and the remainder are merely aerated and allowed to dry during the summer. In storages treated with ozone, surface molds were almost absent and the air in the rooms had a clean, fresh odor. Even in storages where formaldehyde and lime-sulfur had been used the surface molds seemed to have been suppressed.

With few exceptions the Eastern New York storages were much cleaner and better kept than those in Western New York. Of course, the work of keeping the storages clean is made more difficult in Western New York by the need for space in which to store vegetables. In Western New York, one frequently finds various fleshy root vegetables and apples stored in the same rooms. Evidence was not obtained to indicate whether or not the latter practice may result in injury to apples.

Controlled-atmosphere storage rooms (in which oxygen and carbon dioxide levels are controlled) were encountered at 2 different storages. These rooms were filled with fruit of the McIntosh variety and had been opened a few days prior to the survey. Examination of fruit from these rooms revealed only a trace of blue mold rot. Fruit from one of the rooms showed CO_2 injury to the extent of about 1%; this was expected since specialists from the Pomology Department at Cornell had previously learned that the desired levels of oxygen and carbon dioxide had not been properly maintained. The quality of the fruit from the properly managed room was excellent; the fruit seemed as firm, juicy and flavorsome as that just ripened and harvested.

The use of oiled wrappers and of shredded oiled paper for the prevention of apple scald did not appear to be a particularly common practice. Only 3% of all the apple lots examined contained this protective material.

Most of the fruit examined in storage was graded as "tree-run". In Eastern New York the grade "tree-run" appeared to mean that some obviously undesirable fruit had been culled as the crop went into storage. In Western New York the "tree-run" grade appeared more nearly so because much of the fruit examined contained fruits of all sizes and with all sorts of blemishes. The reason for this difference in grading is probably related to the fact that much of the Eastern fruit is marketed as fresh

fruit while in Western New York much of it is processed, as pointed out earlier in this report. Whatever the reason, it appears that the grading and the quality of the fruit encountered made it especially favorable material for examination during a disease survey.

Diseases -- The apple storage survey was timed so as to afford sufficient opportunity for the development of various storage diseases. More than 300 different lots of apples were examined and, in addition, many boxes of throw-outs were examined for the presence of new or unusual troubles. The following diseases were noted: Alternaria rot (Alternaria sp.), gray mold rot, (Botrytis spp.), Phomopsis rot (Phomopsis mali), blue mold rot (Penicillium expansum), scab (Venturia inaequalis), Rhizopus rot (Rhizopus sp.), black rot (Physalospora cydoniae) [P. obtusa], sooty blotch (Gloeodes pomigena), fly speck (Leptothyrium pomi), Brooks fruit spot (Mycosphaerella pomi), bullseye rot (Fusarium sp.), blotch (Phyllosticta solitaria), apple-cedar rust (Gymnosporangium juniperi-virginianae), quince rust (Gymnosporangium germinale) [G. clavipes], bitter rot (Glomerella cingulata), brown rot (Monilinia fructicola), Northern Spy spot (cause unknown), and the following physiological diseases -- bitter pit, internal breakdown, internal browning, water core, common scald, soft scald, and Jonathan spot.

The relative prevalence and severity of the different apple diseases encountered are shown in table 1. Because of the specificity of certain diseases for certain varieties it is emphasized that comparisons between percentage values indicative of the destructiveness of some diseases cannot be made. For example, the prevalence of bitter pit which is especially destructive to Spy and Baldwin should not be compared with blue mold rot which commonly affects many varieties. Examination of the data in table 1 shows that, of the fungus rots of apples, the blue mold rot is in general the most destructive. About 37% of all lots examined exhibited some blue mold rot; in some lots up to 23% of the fruits were affected and an average of 1 fruit out of every 100 is destroyed. The gray mold rot destroys about 1 fruit of every 200 on the average. The Alternaria rot is probably much more destructive than the data in table 1 indicate. The Alternaria rot fungus is frequently associated with insect depredation and, while it does not always rapidly and completely decay the fruits it attacks, it deface many so badly that they are a complete loss. The remaining rots and spots listed in table 1 appear to be relatively unimportant in stored fruit of the 1943 crop.

About one-half of the apple lots examined exhibited scab and an average of 7 fruits out of every 100 were affected. In normal times it is probable that 3 or 4 fruits out of every 100 in the affected lots would be thrown out of the No. 1 grade because of the size of the scabbed area. Heavy storage scab was noted on Baldwin at North Rose, and on Pennsylvania-grown Baldwin stored at Elmira, on Cortlands at Lockport, on Spitzenburg at Holley, and on McIntosh at Clintondale.

Cedar-apple rust was important only in Eastern New York; on variety Rome it was much more important than the values in table 1 indicate.

Of the physiological diseases, bitter pit, internal breakdown, and common scald were the most important. However, a clearer picture of the destructiveness of these diseases is better obtained from values given in table 2 where varieties and their diseases are listed separately.

Comparison of the values for prevalence and severity of the different diseases of apples in overhead-coil storages with those for the same diseases noted in blower-type storages show that most of them were more prevalent and severe in fruits stored in overhead-coil systems (Table 1). It is possible that this is partly attributable to the fact that the blower-type storages are mostly farm storages and grower-owned and that the growers exercise considerable care concerning the condition of fruit that they store. On the other hand, overhead-coil storages are mostly commercial and the managers of these are unable to control the quality of the fruit which they agree to store for their patrons. Furthermore, it is suggested that the fruit is cooled more rapidly after storage in the blower-type systems (owing to rapid air movement and interchange) than it is in overhead-coil systems and therefore, certain diseases, which may become intensified in stored fruit as a result of slow cooling, might well be reduced where the cooling process is speeded.

The relative importance of different diseases of different apple varieties is shown in table 2.

Northern Spy. The most destructive storage diseases of this variety appear to be bitter pit, internal breakdown, and the blue and gray mold rots. Scab was not severe although its prevalence was rather high. With the exception of Spy spot the remaining diseases appeared of little importance.

The disease herein called Spy spot (for want of a better name) deserves special mention. It has been present in New York for several years but its causal agent is unknown. In the present survey the disease was seen on the striped and on the red Spy and on fruits of all sizes down to 2-1/4 inch. It was found on Spys from all parts of the State but was much more severe on fruits grown in Eastern and North Central New York than on fruits grown in Western New York (Wayne County and westward). Apparently the disease is not limited to New York Spys for it was noted on Pennsylvania Spys stored at Elmira, New York, and on Vermont- and Massachusetts-grown Spys stored at Red Hook and other places in the Hudson Valley. The time of the initial appearance of the disease on the fruits is not known, but, of several growers questioned, 2 stated that they had noticed the disease on Spys before they were placed in storage. The symptoms of the disease are in the form of circular to ovate, brown, sharply sunken lesions varying in diameter from the size of a small pencil-point dot to slightly more than 1/8 inch. The lesions usually are located on the stem end and sides of the fruit and there may be 100 or more lesions per fruit. Lesions of all sizes may be present on the same fruit. Sixty-five percent of the different lots of Spys examined exhibited the disease. Up to 47% of the fruits in one lot were affected; in many lots seen in the Hudson Valley and in one lot seen in North Central New York the disease was very severe on individual fruits.

McIntosh. Blue and gray mold rots and common scald were the most destructive storage diseases and approximately 7 to 10% of the fruits were affected with scab. Scab on about one-third of these fruits was severe enough to throw them out of No. 1 grade.

Baldwin. Bitter pit was noted in 61% of the lots examined and up to 51% of the fruits were affected in one lot (Table 2). An average of 4.8% of

the fruits examined in blower-type storages were affected and 7.4% in overhead-coil storages.

Scab was rather prevalent on Baldwin but little of it was severe enough to affect the grade.

Of the other diseases recorded blue mold rot was the most destructive. Gray mold rot, Rhizopus rot, Brooks spot, fly speck, bullseye rot, common scald, and internal browning appeared relatively unimportant.

Rome. Apple-cedar rust was noted in 11 of 28 lots examined; up to 47% of the fruits in one lot were affected (Table 2). About 6 fruits of every 100 examined contained rust lesions, many of which were large enough to reduce the grade. The disease was not seen on fruits grown and stored in Western New York.

Scab was quite prevalent but not severe enough to reduce the grade of many fruits.

Other diseases recorded were rather unimportant although it may be well to mention that a Jonathan-like spot was observed on a few fruits of one lot of Red Rome apples.

Ben Davis. Diseases recorded but not very destructive were Alternaria rot, blue mold and gray mold rots, Rhizopus rot, apple-cedar rust, and bitter pit (Table 2).

Scab was present in 14 of 21 lots of Ben Davis; the average percentage of infected fruits was 14.5. Scab was severe enough on about one-third of the fruits to lower the grade.

Delicious. The fungous diseases recorded were Alternaria, blue and gray mold rots, scab, apple-cedar, and quince rusts. Physiological diseases were common scald, soft scald, bitter pit, water core, internal breakdown, and internal browning (Table 2). Of these only scab, blue and gray mold rots, water core, and bitter pit were very destructive.

Rhode Island Greening. Common scald and internal browning were found to be very destructive to fruit of this variety remaining in storage at the time of the survey. About 17% of the fruit seen in overhead-coil storages was affected with common scald and about 7% with internal browning. The only other disease recorded of any importance was the blue mold decay.

Cortland. Common scald, soft scald, scab, and blue mold rot were the diseases most destructive to fruit of this variety. Other diseases noted but relatively unimportant were Alternaria rot, gray mold rot, Rhizopus rot, and apple-cedar rust.

Northwestern Greening. Fungous diseases recorded on fruit of this variety were Alternaria, blue mold and gray mold rots, blotch, Brooks spot, and scab. Physiological diseases common were soft scald, water core, internal browning and internal breakdown. Only the blue mold rot and common scald appeared to be very destructive.

Golden Delicious. The blue mold rot was the only disease that appeared to be particularly destructive to stored fruit of this variety. Other diseases noted were black rot, blotch, Brooks spot, scab, apple-cedar rust, and soft scald.

Miscellaneous varieties. Diseases that were found to be quite severe on some varieties were: the apple-cedar rust of Winter Banana; scab, blue and gray mold rots of Wealthy; gray mold rot, and common scald of Hendrick's

Sweet; Jonathan spot and blue mold of Jonathan; bitter pit of York; blue mold of Waggoner; scab, bitter pit, and internal breakdown of Tompkins King; scab of Spitzenburg; bitter pit of Mammoth Black Twig; and the blue and gray mold rots of Kendall. More detailed information about the diseases of the above varieties and of others may be obtained from table 2. EMERGENCY PLANT DISEASE PREVENTION PROJECT.

OTHER REPORTS ON DISEASES OF STORED CROPS

APPLE STORAGE DISEASES IN MAINE: The New England Apple Cold Storage in Portland was visited April 1. There are only about 1,000 bushels left out of about 70,000 bushels put in last fall. Most of the apples still in storage are keeping very well. Apples have moved so well this year that the poorer lots had long since been disposed of.

Storage scab (Venturia inaequalis) existed as a trace only on a few lots. Only one lot of Baldwins had any appreciable amount, the prevalence was about 95% and the severity moderate.

Bitter pit (non-parasitic) was present in one lot of Northern Spy. Prevalence was about 10% and severity light.-- R. C. Cassell, Emergency Plant Disease Prevention Project.

CARROT STORAGE DISEASES IN WASHINGTON: The loss in carrots will be large in Yakima and Benton Counties. Poor quality and disease aggravated by extended storage cause this loss. Unselected seed gave a crop of heterogeneous types that could not meet the standards required for processing or market. Leniency in the standards will allow much of the crop to be salvaged. Extended storage has aggravated the loss due to soft rots during recent periods of warmer weather. Most of the crop was in an inaccessible type of storage so no estimate could be made of the loss until the pits were opened.

Black rot (Alternaria radicina) [Stemphylium radicinum] was very prevalent in samples observed in storage and at processing plants. In some cases the rot was not readily evident at the tip of the root but extended a considerable distance up the core. More commonly, the rot was evident as dark sunken areas on the side of the root. The dark rot extended too deep into the root to allow salvage for processing. In some instances as high as 50% of the roots were affected. This disease was not observed in several small lots of carrots observed in Walla Walla County.

Although black rot has been commonly referred to as a storage disease, processors claim this trouble was evident in the first lots of carrots they received this season. Their experience would indicate the primary stages of this trouble may have been before harvest. Weakening or partial breakdown of the tissues due to improper water supply to the maturing crop or to certain soil deficiencies may have been contributing factors. -- Lytton W. Boyle, Emergency Plant Disease Prevention Project. March 6 - 12.

BORAX DIP OF SWEETPOTATOES SAFENED BY THE USE OF CALCIUM SALTS IN THE BEDDING SOILS

Robert H. Daines

In February 1943, the U. S. Department of Agriculture published a pamphlet, AWI-27, entitled "Saving Sweetpotatoes from Black Rot". In this publication a 10-minute soak, before bedding, in a solution of borax at the strength of 1 pound in 5 gallons of water was recommended.

Experiments conducted, intermittently during the past 6 years, in New Jersey, demonstrate that the above recommended dipping solution is very effective for the control of sweetpotato diseases where the fungus involved is borne on the surface of the seed roots, and that in many bedding soils this treatment can be used without causing tissue necrosis as a result of boron toxicity to the sprouts when the treated roots are bedded.

The treatment may produce serious boron poisoning, however, when the bedding sand and the irrigation water used are low in calcium.

In experiments conducted here, as high as 30% of the sprouts produced by boron-treated roots have shown unmistakable boron toxicity symptoms. The most conspicuous symptoms of boron toxicity consist of darkened veins located near the edge of the leaf. This vein-darkening area may progress towards the midrib and the leaf tissue in affected areas usually dies within a few days following the appearance of the blackened veins. It has been found that this type of injury can be largely prevented by mixing small quantities of calcium salts with the sand in which the sweetpotatoes are to be bedded. For example, lime (calcium carbonate) used at the rate of 1/2 pound, or gypsum used at the rate of 1 pound, per 100 square feet, have almost entirely prevented the appearance of necrotic areas as a result of boron toxicity to the resulting sprouts. While preliminary data indicates that the addition of a calcium-containing compound to the bedding sand does not decrease the fungicidal efficiency of the borax dip, further experimentation will be necessary before recommendations can be given.

NEW JERSEY AGRICULTURAL EXPERIMENT STATION, NEW BRUNSWICK

SWEETPOTATO DISEASES IN TENNESSEE

R. A. Hyre

From March 20 to 25 this survey was made in northern central and western Tennessee, from Cookeville to Nashville, Clarksville, Jackson and Memphis.

A number of farms were visited where the bedding of sweetpotatoes was under way. About 2000 bushels were being bedded at one place. A small amount of the usual storage rots were observed in the roots being treated. Soft rot (Rhizopus nigricans) was seen the most frequently. It was found in a few small spots in a week-old bed that had not heated because of a choked flue. It was reported as occasionally spreading through a bed of

the Porto Rico variety and becoming serious unless checked. A copper sulfate drench did not check it. Removing the infested area and loosening the nearby soil to aerate it was quite effective.

Growers stated that black rot (Ceratostomella fimbriata) was not a problem with them but emphasized that stem rot, Fusarium spp., might drive them out of business unless a control for the disease was found. Their problem is to grow stem-rot free potatoes on infested soil as large areas of land in western Tennessee are contaminated with the organisms.

Of 1500 bushels of sweetpotatoes being graded out of storage south of Memphis about 500 bushels were rotted. The principal disease present was Mucor soft rot. Also present was about 2% of black rot (Ceratostomella fimbriata). The sweetpotatoes went into storage with many growth cracks and no control of the storage temperature was attempted.

EMERGENCY PLANT DISEASE PREVENTION PROJECT

DISEASES REPORTED ON POTATO AND TOMATO

DISEASES OF POTATO AND TOMATO IN THE FLORIDA WEST COAST AREA: Surveys in the Ruskin, Sun City, and Ft. Myers areas were continued. Tomatoes continue to be attacked by early blight (Alternaria solani). All large growers are spraying or dusting to reduce leaf infections.

Late blight of potato (Phytophthora infestans) has done great damage wherever potatoes are grown in Southwestern Florida. Several individual fields surveyed the past week may be mentioned. One 80-acre field of potatoes in the Ft. Myers area showed 50% loss from late blight. Another 60 acres of potatoes in the Pine Island district (Ft. Myers) showed 40% loss.

A considerable, but scattered acreage of potatoes is grown in the Bradenton area, and a fairly large concentrated acreage is also grown in rotation with celery on the muck area east of Sarasota. Vines in these areas are younger and late blight is just getting underway in these fields. In a special potato survey in the Sarasota muck area March 25, late blight was found in every potato field with vines 6 inches or more in height. A group of growers were contacted at a central packing plant and apprised of the situation. Infection is scattered and just getting started in most of these late fields, but spreads with great rapidity and destructiveness unless proper fungicidal sprays are applied.-- Week ending March 25.

Week ending April 1. Both early (Alternaria solani) and late (Phytophthora infestans) blight continue to cause great damage to potato fields in the West Coast area. Early blight is more serious on light soils and on fields following a fall crop of tomatoes. Late blight is widespread and its injury to the spring crop of potatoes will depend on weather conditions and the efficiency of the spray control program. Late spring potatoes, many fields only recently planted, are grown commercially mainly in the Sarasota area, where they are grown in crop rotation with celery.

Virus diseases are present in all potato fields examined, but probably will not cause above 5% damage, on the average. In tomatoes their injury

is more serious. Many fields of tomatoes (not yet bearing) in Northern Manatee County were inspected where the proportion of mosaic plants varied from 10 to 50%, and it appeared likely the final damage in these fields from mosaic would probably exceed these percentages. Two fields were seen in which nearly 90% of the plants showed symptoms of virus diseases, believed to be mainly common tobacco mosaic, although in a few plants it might have been Aucuba mosaic.

Tomatoes in the West Coast area continue to be seriously injured by early blight. Weather conditions during the past 10 days have been favorable for its spread, particularly in Manatee County. Several fields, just at the first bearing stage of growth, were seen that appeared to be nearly a total loss from early blight, which spread with great rapidity following a 3-inch rain 10 days ago. Gray leaf spot (Stemphylium solani) is also present in every field examined, but its effect is overshadowed by early blight which is usually present on the same plants. Zinc deficiency disease ("galloping rust") was present in many fields, but its effect was difficult to assess, as early blight and mosaic were usually also present. One bearing field was inspected in which a large percentage of the fruits of picking size showed a black or discolored center when cut open. This would appear to be a deficiency disease of undetermined origin. Mosaic was also very bad in this field. Another grower in the same district has 150 acres of tomatoes which will produce 10% or less of a normal crop, owing to a combination of diseases. Much of this acreage will probably be abandoned. In addition to mosaic, early blight, and gray leaf spot, the plants in these adjacent fields, which formed one large block, were badly stunted, but not wilted. Verticillium root rot and wilt was suspected. Isolations and inoculations are being made by Dr. A. E. Harrison of the Vegetable Crops Laboratory at Bradenton. -- C. M. Slagg, Emergency Plant Disease Prevention Project.

MOSAIC OF POTATO IN MISSISSIPPI: The potato crop appears to be making a slow start in the Columbia area (Marion County). In one field of about 20 acres an estimated 5 to 7% of the plants showed rugose mosaic [virus].-- Douglas C. Bain, Emergency Plant Disease Prevention Project. Week ending April 1.

POTATO VIRUS DISEASES IN LOUISIANA: Most of the spring crop potatoes in Louisiana are grown in Terrebonne, LaFourche, and Pointe Coupee Parishes. At present, the plants in many of the fields are as high as 15 inches. This week (March 20-25) an attempt was made to survey these areas thoroughly but heavy general rains in the early part of the week prevented extensive field work. No survey was made in LaFourche Parish. The crop in general appears to be in good condition at present. Rugose mosaic [virus] was found in all of the areas surveyed, in amounts varying from a trace to about 10%. The highest percentage of infection was found in one field of about 30 acres of the Triumph variety near Houma (Terrebonne Parish). According to the grower, most of the seed potatoes had come from Nebraska. Only a trace of mild mosaic [virus] was found in Terrebonne Parish and none elsewhere. -- Douglas C. Bain, Emergency Plant Disease Prevention Project.

VIRUS DISEASES IN OHIO WAR-APPROVED SEED POTATOES: In a previous report mention was made of testing 4 samples of war-approved seed potatoes. These tubers were planted in the greenhouse and as the plants emerged were observed for the presence of virus diseases. The samples were as follows:

Grower	Variety	Number of tubers tested
No. 1	Katahdin	25
No. 2	Russet Rural	25
No. 3	Katahdin	25
No. 4	Erie	100

Diseases found. -- Leaf roll was present on one plant of Grower No. 2 and on two plants of Grower No. 3. Spindle tuber was found on one plant of Grower No. 4. No other virus diseases were observed on these plants. This test indicates that these four lots of potatoes were from seed stock of a high quality and well above the standards set for war-approved seed. -- M. R. Harris, Emergency Plant Disease Prevention Project. March 20 - 25.

TOMATO PLANT SITUATION IN GEORGIA: The matter of producing plants for the greater part of the tomato-canning industry is a problem of immediate concern. Of the 7000 acres that should have been planted to date, 3000 acres have been planted; 1000 acres of which is a total loss. Only about 1/4 of the remaining 2000 acres or about 500 acres can be counted on to come through. Only about 10 days of planting time remain in order to have plants for the normal setting season in the Middle West. The Maryland and New Jersey section is already delayed. The part that disease has played in the situation cannot be estimated accurately. However, it can be said that damping-off has played an important part in lessening the stands of plants. -- G. M. Stone, Emergency Plant Disease Prevention Project. March 30.

DAMPING-OFF OF TOMATO IN TENNESSEE: Below Nashville several tomato seed beds were observed. In 1 bed about 25,000 seedlings damped off out of a potential of about 35,000 seedlings (5 oz. of seed). This had been a tomato seedbed for 3 years without the soil having been changed or treated. Other smaller amounts of damping-off were observed in the same community. -- R. A. Hyre, Emergency Plant Disease Prevention Project. March 20 - 25.

CONDITION OF TOMATOES IN OHIO GREENHOUSES: During the past week inspections were made of a number of greenhouses in the Cincinnati area. Most of the tomato plants are now about a foot high and putting out first flower clusters. These plants were interplanted with lettuce and have been crowded in their growth. The lettuce is being cut and as the tomato plants are freed from growth competition with the lettuce a more sturdy type of growth begins. In one house the tomato plants were making a very rapid vegetative growth but setting no fruit due to an excess of nitrogen applied to the lettuce. This condition was remedied by the grower pushing

a spading fork under each plant and partially lifting it out of the soil. Then the plant was allowed to settle back to its original position, but in the process of being lifted many roots were broken off. The shock to the plant had the effect of slowing its growth and causing the flowers to set fruit.

In another greenhouse the plants were about four feet high with four flower clusters. When the two lower clusters were receptive to pollen no pollen was produced due to dark short days. The grower resorted to the use of indole-butyric acid which was atomized onto the stigmas. Perfect fruit setting resulted. The acid burned the sepals slightly causing them to have a straw color.

In two of the houses inspected there was no evidence of tobacco mosaic. Neither grower employed outside labor and neither grower uses tobacco. The mosaic-free plants were very vigorous and were making a growth considerably better than plants in other houses where mosaic is present on nearly all of the plants. -- M. R. Harris, Emergency Plant Disease Prevention Project. March 27 - April 1.

DISEASES OF VEGETABLE CROPS GROWN FOR SEED IN OREGON

Lytton W. Boyle

From March 22 to 23, accompanied by Dr. Glenn Pound and Dr. P. W. Miller, cabbage seed crop plantings were observed in the vicinity of Corvallis, Albany, Coburg, Lancaster, Eugene, and Oswego, Oregon. On the whole these plantings had made good development and prospects of a seed crop are favorable at this time.

Winter Injury. Plant beds were sown from June 5 to July 10. Transplantings from such beds were made from August to December.

Transplantings in August made considerable development of fairly compact heads. These were not resistant to injury by frost. Such injured tissue proved an excellent culture medium for soft rot organisms and in many cases this progressed to the center of the head including the tip of the stalk. Such plants were making a late effort to start shoots from buds at the base of the stalk. Unless the weather stays comparatively dry, there is no assurance that the soft rot may not progress further down the core of the stalk.

Transplantings made during September and October appeared most promising. These had withstood the winter temperatures well and had started to bolt at this date.

Traces of ring spot (Mycosphaerella brassicicola) were noted on old leaves of a harvested planting near Oswego.

Three types of fields were apparent in respect to the prevalence of mosaic virus infection:

Type 1. Fields on farms where crucifers had not been grown for seed previously and the seed beds consequently removed from old plantings -- severe clear cut symptoms were not found in such fields. A small percentage of plants showed somewhat masked symptoms at this time.

Type 2. Fields on farms where plant beds had been adjacent to last seasons seed crop. -- From 25 to 50% of such plantings showed more distinctly the vein banding type of symptom.

Type 3. Fields of plants that had been imported from areas known to be badly infested with mosaic. -- These fields showed 50 to 75% infection including both the mottle and vein banding type of symptoms. This disease may readily become a serious factor in production of cabbage seed if precaution is not taken to protect plant beds from sources of infection in older plantings.

Near Albany a trial planting of mangels was observed. About 50% of the plants showed symptoms of mosaic. Leaf spot (Rumularia betae) was also very prevalent on the older leaves.

Fields of vegetable seed crops being grown for lend lease in Washington and Yamhill Counties were visited on March 25 with government officials and seedsmen responsible for their inspection and production.

A field of garden beets showed severe injury from frost in Yamhill County. The roots had not been covered during the winter. This is the first instance of winter injury to beets noted in this general area. Plantings in surrounding areas withstood temperatures of the current season without special protection. About 2/3 of the roots will be unfit for use as seed crop. No history of this field is available to determine why it was more susceptible to low temperatures. It is suspected some disease may have been prevalent on the leaves this past season to weaken the plants, although the roots had gained good average size.

An incipient infection of downy mildew (Peronospora parasitica) was noted on older leaves of rutabaga.

On cabbage soft rot was prevalent in the fields that had been transplanted early and had formed heads during last fall season. These were not hard but tightly enclosed by the outer leaves. The relatively high temperature of the inner head was very evident as the hand was struck into them. Mosaic was evident in one field but only a small percentage of the plants appeared to be infected at this time. Ring spot was not noted in these fields.

EMERGENCY PLANT DISEASE PREVENTION PROJECT.

CONDITION AND DISEASES OF VEGETABLE CROPS IN VARIOUS AREAS

CONDITIONS AFFECTING THE CROP SITUATION IN GEORGIA: Extremely heavy rains have continued in Georgia. In excess of 14 inches have fallen here at the Experiment Station in March. This is more than 3 times the normal March, and about 1/3 of the yearly normal. As a result, the crop situation in the State is really serious. Little to no cotton or corn has been planted. Only a few small "patches" of tobacco have been set, and the late winter and early spring vegetable crops are suffering tremendously from the excess water. Diseases of all crops have been so complicated by the weather conditions that intelligent observations have been impossible. However, a few reports are given (see tomato plant situation, and reports on cabbage downy mildew, pea diseases, and tobacco downy mildew). -- G. M. Stone, Emergency Plant Disease Prevention Project. March 30.

VEGETABLE SEEDLING DISEASES IN TENNESSEE: Many vegetable seedlings were seen in several greenhouses and in numerous outdoor beds, including those at the Shelby County Penal Farm, all near Memphis. A small amount of damping-off of tomato seedlings was seen at the Penal Farm. Dodder was present on various seedlings at the same place and is a yearly problem there. A trace of downy mildew (Peronospora parasitica) was seen on cabbage seedlings but this disease was unimportant. Reports indicated no other acute disease problem present. The soil in the beds usually is changed yearly; but every 2 years in one case. -- R. A. Hyre, Emergency Plant Disease Prevention Project. March 27 - 31.

SOIL DEFICIENCY TESTS IN OHIO: Earlier, an endive field in Stark County was described as showing symptoms of mineral deficiencies in the soil, (PDR 27(22): 630. Nov. 1, 1943). Tests of this soil have been made by growing plants that react with positive symptoms to a lack of mineral elements. To soil samples in stone jars have been added boron, manganese, magnesium, potash, copper, and zinc. Test plants of endive, soybean, and tomato were grown. Check plants in untreated soil were grown to show deficiency symptoms.

Results indicate that the soil lacks boron, magnesium, and possibly manganese. Endive plants that received boron were more vigorous and had a better color than plants grown in untreated. Tomato plants in untreated soil showed an uneven yellow spotting of the leaves not seen on the plants treated with boron. Soybean plants showed a leaf condition indicating a lack of both boron and magnesium. Plants to which manganese was given showed an increased vigor, which indicates a lack of that mineral in the soil.

On a basis of what these test plants show this muck soil would be much improved by the addition in small amounts of those minerals necessary for plant growth but not commonly found in the average commercial fertilizer, -- M. R. Harris, Emergency Plant Disease Prevention Project. March 20 - 25.

CABBAGE DOWNY MILDEW IN GEORGIA: An interesting observation was made on cabbage seedlings in plots on the Experiment Station farm at Tifton. In this section, downy mildew (Peronospora parasitica), while usually everpresent during the plant season, seldom causes serious damage. Dr. W. D. Moore made a late seeding of cabbage in a field where old plants provided abundant inoculum. The ensuing severe attack of downy mildew in the early seedling stage all but wiped out the stand of plants; which goes to show that downy mildew under certain conditions might be an important disease of cabbage. -- G. M. Stone, Emergency Plant Disease Prevention Project. March 30.

CABBAGE DISEASES IN TENNESSEE: About a dozen seedbeds and 10 or more acres of cabbage just set in the field were observed near Nashville and Humboldt. On 4 beds near Nashville 10% loss from wire stem (Rhizoctonia solani) occurred. The seedbed soil was re-used and not treated. No downy mildew was observed either at Nashville or around Humboldt. The growers report it as being no problem with them. -- R. A. Hyre, Emergency Plant Disease Prevention Project. March 20 - 25.

BORON DEFICIENCY AFFECTING CAULIFLOWER IN THE FLORIDA WEST COAST AREA: A 20-acre field of cauliflower in Hillsborough County was inspected when harvesting and packing for shipment were under way. More than 50% of the heads, when cut across, showed a dark center, which in some cases extended to the outer surface of the head. This was diagnosed as a boron deficiency disease. -- C. M. Slagg, Emergency Plant Disease Prevention Project. Week ending April 1.

POWDERY MILDEW ON RADISHES IN OHIO GREENHOUSES: A number of greenhouses in the Cincinnati area were inspected. In several greenhouses radishes were being grown. The plants were healthy but earlier during dark weather some damage was done by an infection of mildew. This is believed to be Erysiphe polygoni. -- M. R. Harris, Emergency Plant Disease Prevention Project. March 27 - April 1.

EARLY BLIGHT OF CELERY IN THE FLORIDA WEST COAST AREA: Cercospora apii continues its damaging attack in the Sarasota area. All growers use protective fungicides to control this disease. One field was seen where a small acreage had been abandoned because the leaves and stems were badly diseased. -- C. M. Slagg, Emergency Plant Disease Prevention Project. Week ending March 25.

DOWNY MILDEW OF CUCURBITS IN THE FLORIDA WEST COAST AREA: Cucumbers and squash are seriously damaged by downy mildew (Peronoplasmopara [Pseudoperonospora] cubensis) in all areas. This same disease was also found on watermelons in the Ft. Myers area, but its attack on watermelons is not so severe as on cucumbers and squash. One 80-acre field of cucumbers 2 miles southeast of Ft. Myers was abandoned as a total loss from the disease. -- C. M. Slagg, Emergency Plant Disease Prevention Project. Week ending March 25.

LETTUCE DISEASES IN OHIO GREENHOUSES: In none of the houses inspected in the Cincinnati area was any tip-burning seen except a plant or two in a dark corner of one greenhouse. The Grand Rapids strain of lettuce is being grown. Several of the houses seen showed severe tip-burning when inspected in November, 1943. Better light conditions seem to eliminate tip-burn. In two houses Sclerotinia sclerotiorum was killing an occasional plant. In one house a species of Botrytis attacked the young plants just after they were set out but killed only the older leaves. The plants became established and grew away from the fungus. -- M. R. Harris, Emergency Plant Disease Prevention Project. March 27 - April 1.

DISEASES OF ONIONS, SHALLOTS, AND GARLIC IN LOUISIANA: During the past month a dying back of leaves has been noted in these plants in Terrebonne and nearby Parishes. No fungi of parasitic nature have been found on the leaves. The condition is similar to the disease known as "blast", which is described by L. H. Jones (Relation of weather conditions to onion blast. Plant Physiology 19: 139-147. 1944). It should be noted that in December, January, and early February, the weather was mild and quite rainy at times. These periods were followed by warm, dry weather and

bright sunshine. These conditions appear to be favorable for the development of blast,

A trace of yellow dwarf [virus] was found in shallots along Bayou De Glaises in Avoyelles Parish. Considerable injury due to thrips is common and general in Terrebonne and neighboring Parishes. -- Douglas C. Bain, Emergency Plant Disease Prevention Project. March 20 - 25.

PEA DISEASES IN GEORGIA: Downy mildew (Peronospora viciae) [P. pisi], always a serious disease of "English" peas in southern Georgia, was observed on the Experiment Station farm on March 21, which is earlier than it usually appears. Bacterial blight (Bacterium [Pseudomonas] pisi) was also found on a few plants. -- G. M. Stone, Emergency Plant Disease Prevention Project. March 30.

POWDERY MILDEW ON PEAS IN LOUISIANA: Powdery mildew (Erysiphe polygoni) is beginning to show up on the lower leaves of mature plants in gardens in LaFourche and Terrebonne Parishes. -- Douglas C. Bain, Emergency Plant Disease Prevention Project. March 20 - 25.

PEA DISEASES IN MISSISSIPPI: Several fairly large fields were surveyed near Hazelhurst (Copiah County). In some plantings downy mildew (Peronospora viciae) [P. pisi] was general but not serious. In one field between Crystal Springs and Hazelhurst there was considerable damage due to rotting of stems at the soil line and above. Rhizoctonia was found to be associated with this condition. -- Douglas C. Bain, Emergency Plant Disease Prevention Project. Week ending April 1.

PHYTOPHTHORA ROOT ROT OF SPINACH IN CALIFORNIA: In an earlier report (PDR 28(4/5): 127), mention was made of a root rot of spinach collected by Dr. M. W. Gardner and myself in the vicinity of Salinas. Pure cultures of a species of Phytophthora were obtained in isolations from these diseased roots. This fungus has since been identified as Phytophthora megasperma by Dr. J. T. Barrett, Pathologist at the California Agricultural Experiment Station. This appears to be the first report of this disease, root rot of spinach caused by Phytophthora megasperma. The conditions under which this disease developed were very similar to those under which the root rot of crucifers caused by the same species develops. -- Horace L. Barnett, Emergency Plant Disease Prevention Project. March 28.

CITRUS ROOT NEMATODE IN FLORIDA

A. L. Taylor

During the period March 13 to March 24, citrus plantings in the vicinity of Lake Alfred and Orlando, Florida, were examined, the special object of the search being the citrus root nematode, Tylenchulus semi-penetrans.

This nematode has been reported as a parasite of a number of economically important species of Citrus and related genera in many parts of the world. In the United States, it has often been found in California, but

only a few times in Florida. The best available evidence as to its importance as a factor in the growth of citrus is contained in the paper by E. E. Thomas, The Citrus Nematode, Tylenchulus semi-penetrans (Calif. Agr. Exp. Sta. Tech. Paper No. 2. 1923), which states that "among the hundreds of trees examined, every heavily infested tree showed evidence of injury", but that lightly infected trees had no symptoms.

Through the courtesy of Dr. A. F. Camp and Mr. W. L. Thompson, of the Florida Citrus Experiment Station at Lake Alfred, root samples from various experimental and commercial plantings in the vicinity of Lake Alfred were examined. These included roots from normal trees, typical "declining trees", old trees and trees in neglected groves. Rootstocks were mostly rough lemon, but a few sour orange, grapefruit, and seedling sweet orange roots were also examined. No citrus root nematodes were found on any samples from this area. It is felt that enough samples were examined to make certain that the citrus root nematode is not common in this locality.

Associated with the roots examined were small numbers of ectoparasitic and free living nematodes of the genera Criconemoides, Rhabditis, Acrobeles, Dorylaimus, Aphelenchoides, and Cephalobus, but there was no evidence that these were of any great practical importance.

At Orlando, Experimental plantings of Citrus and Citrus relatives were examined at the Bureau of Plant Industry Station. The citrus root nematode had previously been found on the grounds of the experiment station here. Moderate infections were again found on orange and grapefruit trees on sour orange rootstocks (Citrus aurantium). In addition, light infections were found on Cuban shaddock (C. grandis). On trees transplanted from the Experiment Station grounds to the Experiment Station Farm, light infections were found on grapefruit on Cleopatra mandarin rootstocks (C. reticulata), on orange on rough lemon rootstock (C. limon), and on orange on sour orange. Nursery trees on various rootstocks at the farm were not found infected.

Species related to Citrus were examined at the Experiment Station grounds. Box orange (Severinia buxifolia), Baelfruit (Aegle marmelos), Atlantia sp., Chinese Wampee (Clausena lansium), Hesperethusa crenulata, and Glycomis sp. were not found to be infected with Tylenchulus semipenetrans, but it could not be determined whether this was due to resistance or to accident. Hesperethusa crenulata and Glycomis sp. were lightly infected by the rootknot nematode (Heterodera marioni). In passing, it should be noted that the rootknot nematode was not found in any other samples examined, although this pest is found on many other plants in this region.

It should be emphasized that no general conclusions respecting the citrus root nematode in Florida are justified from the data collected on this survey, restricted as it was by lack of time to a comparatively small number of root samples from a fraction of the citrus area. Nothing was found that would indicate that the citrus root nematode is widely distributed in the areas examined. Its presence in the grounds of the Experiment Station at Orlando is easily explained by the fact that these grounds have been used for many years for planting experimental and specimen citrus plants, many of them originating outside of Florida. The nematode was not found on the Experiment Station Farm except on trees trans-

planted from the Experiment Station grounds.

Recommendation. A more extensive and thorough survey of the citrus growing regions of Florida should be conducted.

EMERGENCY PLANT DISEASE PREVENTION PROJECT

BROWN ROT AND RUST ON STONE FRUITS IN CALIFORNIA

Horace L. Barnett

During the period March 12 to 25 the work consisted mainly of the continuance of the brown rot of stone fruits survey. Observations and collections, principally of almonds and apricots, were made in the following counties: San Joaquin, Stanislaus, Merced, Monterey, San Luis Obispo, Santa Clara, Sutter, Butte and Colusa. Observations were also made on peaches in Sutter and Yuba Counties.

The trip to Monterey and San Luis Obispo Counties was made in company with Mr. C. E. Scott, Extension Pathologist of the California Experiment Station. The one-day trip into Santa Clara County was made in company with Dr. H. E. Thomas, Pathologist in the California Experiment Station.

Since the blossom blight phase of brown rot of stone fruits is dependent upon the rainfall during the period when the blossoms are open, it is necessary to point out that in the above mentioned fruit growing districts general precipitation fell during the first few days of March. Since that time there has been no precipitation in these areas. At that time the early-flowered varieties of almonds were almost in full bloom with some blossoms open in the later varieties. Likewise, some apricot blossoms were open.

In general blossom and twig infection was comparatively light throughout all areas inspected. The heaviest damage on almonds was observed in the Chico district in Butte County and in a small area near King City in Monterey County. On individual trees of the Drake variety, approximately 30% of the fruit spurs were blighted. On other varieties the estimated percentage was less than 10. No attempt was made to estimate the percentage of damage throughout any certain district because of the great variation in the different varieties of almonds and differences between sprayed and unsprayed orchards.

A small amount of blossom and twig blight of apricots was found in all areas surveyed but in no district was it serious this season. The heaviest infections were found in Alameda County.

No blossom blight has yet been observed this season on peach, prune or cherry.

While in Sutter and Yuba Counties, one of the largest peach growing districts in the State, a search was made for apothecia of the brown rot fungus (Sclerotinia [Monilinia] fructicola). The peaches were in full bloom at this time. Over most of the area the soil was apparently too dry for the apothecia to be formed. However, approximately 50 apothecia were found in one orchard in which the soil was still moist from a recent irrigation and in which a heavy cover crop of oats was still present. A single apothecium was found in another orchard. A number of these apothecia were observed to discharge their ascospores when collected. These

observations indicate that abundant ascospores may be present in some of these peach orchards, but because of the dry conditions no blossom infection has yet occurred.

Up to the present time all cultures obtained from isolations from blighted almond blossoms have been Sclerotinia [Monilinia] laxa. Three cultures of S. fructicola were obtained from blighted apricot blossoms collected in Santa Clara County. All other cultures from apricot blossoms were S. laxa. A complete summary of the blossom and twig blight survey will be given at a later date.

A few mummied apple fruits showing sporodochia of the brown rot fungus were found in Sutter County north of Yuba City. These were collected from trees in an orchard just across the road from a peach orchard. Cultures are being made to determine the species of the fungus.

Shot hole of young leaves and blossom blight (Coryneum beijerinckii) [Coryneum carpophilum] were found on almonds in the Paso Robles area (San Luis Obispo County) on the west side of the valley. Both phases of the disease were light at this time. Coryneum infection of almond blossoms was also found in Contra Costa County.

Some frost damage to almonds was noted, especially in Contra Costa County, Butte County, and in the low areas in San Luis Obispo County. At this time it was difficult to determine the extent of the damage.

While in the vicinity of King City a search was made by Mr. Scott and myself for green last-season's leaves on sucker shoots of almond which might be infected with rust (Tranzschelia pruni-spinosae). Since the infection of the alternate host seems to be a rare occurrence in the State, it was thought that these old green leaves might carry the rust fungus over winter. A considerable number of these almond leaves that were producing abundant uredia were found in the orchards. (This report is in contradiction with the observations reported for the same area for the week ending February 19). Young leaves of the current season's growth were also present on the same shoots, although no new rust infections were observed at this time. These observations give evidence of the manner in which the rust may be carried from year to year in this area without the infection of the alternate host. It is thought that careful rogueing of these sucker shoots in the almond orchards during the winter will eliminate or greatly reduce this carry over of the rust.

EMERGENCY PLANT DISEASE PREVENTION PROJECT.

OTHER REPORTS ON DISEASES OF FRUIT CROPS

PEAR LEAF SPOT IN LOUISIANA AND MISSISSIPPI: Two large pear orchards were visited in St. Tammany Parish in Louisiana. Leaf spot (Fabraea maculata) was general on all trees and appeared to be severe on many.

In Mississippi trees in small orchards in parts of Lamar and Pearl River Counties showed a considerable amount of leaf spot, but no extensive defoliation was apparent. -- Douglas C. Bain, Emergency Plant Disease Prevention Project. Week ending April 1.

STRAWBERRY DISEASES IN LOUISIANA: Several large fields were surveyed in Tangipahoa Parish. Between 50 and 75% of both green and ripe berries were rotting in all fields observed. Gray mold (Botrytis sp.) was evident everywhere. Traces of tan rot (Pezizella lythri) and of leather rot (Phytophthora cactorum) were found in some fields. One grower with 14 acres estimated that in the past week he lost about 2/3 of his berries in the field and at the packing shed. The general condition appears to have been brought about or aggravated by rainy periods. -- Douglas C. Bain, Emergency Plant Disease Prevention Project. Week ending April 1.

DISEASES OF ORNAMENTALS IN GREENHOUSES IN MISSOURI

T. W. Bretz

During the 2-week period ending March 25, 1944, the major greenhouses in the Kansas City and St. Joseph areas were inspected with Mr. J. Allison Denning, State Entomologist and Mr. Lester Davis, Assistant Entomologist of the State Department of Agriculture. Most of the ranges visited in these areas are devoted to the culture of cut flowers, principally roses, carnations and snapdragons. However, as the following report indicates, a number of other ornamentals are grown less extensively either as potted specimens or for sale as cut flowers. Except as noted the diseases observed were of minor importance and caused no extensive losses. The presence of certain controllable and potentially serious diseases may probably be accounted for by the lack of sufficient labor to maintain as thorough a program of protection as would be desirable.

Antirrhinum (Snapdragon) - Rust (Puccinia antirrhini) was noted in one range. In general infection was confined to the foliage, but in a few locations severe stem infection was present, accounting for the death of the plants thus affected.

Gray mold (Botrytis sp.) was observed in all plantings, causing a branch, stem and blossom blight. In no instance was the damage extensive.

Fasciation (cause ?) - In 2 of the ranges an occasional plant was observed that had developed much flattened stems and inflorescences.

Azalea - "Pinkster" Gall (Exobasidium vaccinii). This disease was observed causing minor damage to a few plants in one range. It was kept in check by picking the affected leaves and destroying them.

Begonia - Gray mold (Botrytis sp.). In a range where the plants were situated in an excessively moist habitat, considerable damage was resulting from a leaf and flower infection by this organism.

Calendula (Pot Marigold) - Gray mold (Botrytis sp.) was responsible for a blighting of approximately 10% of the inflorescences in one of the ranges visited. It was of distinctly minor importance on this suscept in other houses, however..

Chrysanthemum - Leaf spot (Septoria chrysanthemella) was prevalent in the majority of the stock plants observed. Infection was most pronounced on the older leaves and except in occasional instances, the cuttings secured from these stock plants were not visibly diseased.

Stem rot (Sclerotinia sp.). In one bed of stock material the mycelium and sclerotia of this pathogen were noted on a few dead plants. Whether this fungus was primarily responsible for the death of the plants could not be ascertained.

Fasciation (cause ?). A single stock plant exhibiting the broad, much-flattened stem of this abnormality was observed.

Dianthus caryophyllus (Carnation) -- Rust (Uromyces caryophyllinus) was noted in all ranges. The disease was much more prevalent in the cuttings (most of which were purchased elsewhere) than in the bench stock.

Stem rot (Rhizoctonia solani) was generally prevalent in the houses visited. Damage was confined to limited areas in the benches, indicating incomplete sterilization of the soil.

Branch rot (Alternaria dianthi) was also prevalent in the majority of the ranges, causing moderate damage.

Gray mold (Botrytis sp.) was responsible for a serious blossom blight in one range. An estimated 5% of the blossoms were affected as the buds were opening.

Dracaena - Leaf spot (tentatively identified as Phyllosticta maculicola) was observed causing some disfiguration of the foliage.

Gardenia jasminoides (Gardenia) - Root knot (Heterodera marioni). An occasional potted specimen of this plant in a poor state of vigor showed a moderately heavy nematode infestation.

Bud drop (physiogenic) appeared to be of distinctly minor importance in the plantings observed.

Hydrangea - Powdery mildew (Erysiphe polygoni) was prevalent in the majority of the potted specimens and bench stock. In no instance was it responsible for much damage, but it constituted a potentially dangerous problem in a few of the ranges.

Chlorosis (physiogenic) was observed to some extent in all ranges.

Lathyrus odoratus (Sweet pea) - Fasciation (Phytomonas fascians ?) [Corynebacterium] of branches developing near the soil line from otherwise normal vines was observed in one range. Fully 75% of the planting was affected.

Bud drop (physiogenic) was observed but considered to be of minor importance.

Lilium sp. (Easter lily) - Yellow flat ? (virus). In the majority of ranges forcing lily bulbs, a few plants were observed that failed to grow properly and possessed the characteristics ascribed to this virus disease.

Mosaic (virus). An occasional plant was observed with the characteristic symptoms of the mosaic disease.

Split buds (cause ?). In one range, 50% of the plants showed the buds splitting lengthwise of the corolla prior to opening. No unusual cultural practise had been employed in forcing these plants that might have accounted for this behavior.

Pelargonium (Geranium) - Oedema, dropsy (physiogenic) was noted in most lots of potted geranium specimens examined. In no instance had the disturbance progressed to the extent of causing appreciable damage.

Gray mold (Botrytis sp.) was prevalent, causing slight damage to the blossoms and foliage.

Petunia - Mosaic (virus). In one lot of potted specimens the mottled, distorted foliage characteristic of this disease was noted on about 1/3 of the plants.

Rosa (rose) - Black spot (Diplocarpon rosae) was prevalent in all the bench roses examined. In no instance was the infection serious enough to account for much disfiguration or defoliation except in a few benches that were being forced into a period of rest and were uncared for.

Powdery mildew (Sphaerotheca pannosa) was most prevalent on potted specimens and recently set bench plantings. A trace was also noted in old, established bench plantings. In all cases the infection was light and of recent origin, causing little apparent damage.

Stem canker (Coniothyrium sp.). In all old, established bench plantings varying degrees of die-back and stem canker were observed, usually originating at a pruning scar.

Saintpaulia (African violet) - Ring spot (physiogenic). All lots of this ornamental showed varying degrees of chlorosis.

Sanseveiria - Leaf spot (Fusarium moniliforme) was noted affecting a few potted specimens. The damage was of minor importance.

Verbena - Mildew (Erysiphe cichoracearum) was noted in destructive proportions on one lot of potted specimens.

Zantedeschia aethiopica (calla lily) - Soft rot (Erwinia aroideae ?). Approximately 3% of the plants of this species were rotted off at the soil line. The corms were in advanced stages of decay, soft and slimy in consistency and giving off a foul odor.

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BRIEF NOTES ON PLANT DISEASES

TOBACCO DOWNY MILDEW IN GEORGIA: Blue mold [downy mildew, Peronospora tabacina] reached its peak of development in Georgia about March 20. All beds, except one, visited at that time had mold. Damage has been unusually light; only a few beds were found where an actual loss occurred and in these cases not more than 10% of the plants had been killed. In fact, blue mold, in checking the growth of the plants, has probably been advantageous since setting in the field has been delayed. Nutritional deficiencies were evident in many beds. -- G. M. Stone, Emergency Plant Disease Prevention Project. March 30.

LEAF SPOT ON ALOE IN FLORIDA: An undetermined leaf spot on Aloe vera was collected near Bradenton. This grower stated he would abandon the growing of this crop if this spot continued to spread. Specimens were forwarded to Dr. Erdman West at Gainesville for identification. -- C. M. Slagg, Emergency Plant Disease Prevention Project. Week ending March 25.